Digitized by the Internet Archive
in 2024

https://archive.org/details/livesofgameanima0000unse

LIVES
OF
GAME ANIMALS

PLATE I.—THE FOREST-PLANTER

LIVES

OF

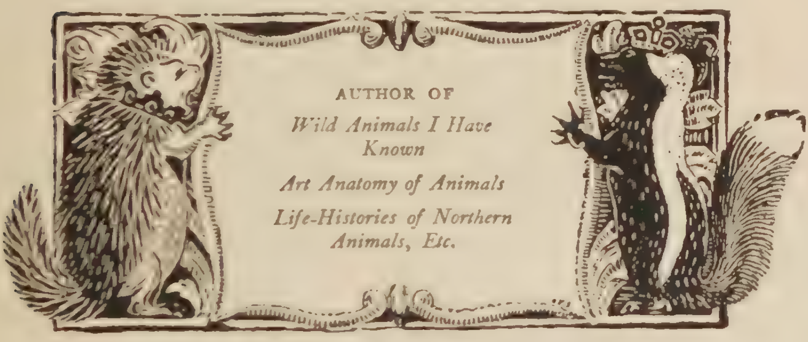
GAME ANIMALS

An Account of those Land Animals in America,
north of the Mexican Border, which are considered
"Game," either because they have held the Attention
of Sportsmen, or received the Protection of Law.

BY

ERNEST THOMPSON SETON

FELLOW NEW YORK ZOOLOGICAL SOCIETY
MEMBER NAT. INST. ARTS AND LETTERS



AUTHOR OF
Wild Animals I Have Known
Art Anatomy of Animals
Life-Histories of Northern Animals, Etc.

WITH 50 MAPS AND 1500 ILLUSTRATIONS
BY THE AUTHOR

VOLUME IV

RODENTS, ETC.

GARDEN CITY NEW YORK
DOUBLEDAY, DORAN & COMPANY, INC.

COPYRIGHT, 1909, 1928, BY
ERNEST THOMPSON SETON

ALL RIGHTS RESERVED

PRINTED IN THE UNITED STATES
AT
THE COUNTRY LIFE PRESS, GARDEN CITY, N. Y.

ACKNOWLEDGMENTS

Acknowledgment of assistance on special points is made in the text. But that of the larger assistance covering sections of the book may be made here.

I am first and deeply indebted to the Biological Survey for much information, and for essential assistance in correcting the maps; also through its individual members, as hereinafter noted, for careful collaboration that amounts almost to a complete endorsement of the work.

To the U. S. National Museum and to the American Museum of Natural History for free access to their valuable collections; and to the former for electros from Mearns's "Mammals of the Mexican Boundary."

To the University of California for maps and publications.

To the editor and staff of *Forest & Stream* for continual coöperation in the search of their files and help in matters of ancient record.

To the New York Zoological Society for the use of certain of my own drawings.

To the Hon. J. B. Harkin, O. S. Finnie, and Maxwell Graham, of the Department of the Interior, Ottawa, for documentary information on the fauna of Canada.

To the following zoologists for critical reading of the Life indicated:

Gray-squirrel.—Vernon Bailey, Biological Survey.

Gray-squirrel Habits.—Dr. Lillian Delger Powers, White Plains.

California Gray-squirrel.—Frank Stephens, San Diego Museum.

Tasselear Squirrel.—Dr. Hartley H. T. Jackson, Biological Survey.

Fox-squirrel.—Arthur H. Howell, Biological Survey.

Apache Squirrel.—Dr. Hartley H. T. Jackson, Biological Survey.

Arizona Squirrel.—Dr. Hartley H. T. Jackson, Biological Survey.

Red-squirrel.—Edward A. Preble, Biological Survey.

Douglas Squirrel.—Stanley G. Jewett, Biological Survey.

Fremont's Squirrel.—Edward R. Warren, Museum of Colorado College.

Little Chipmunk.—Harold E. Anthony, American Museum of Natural History.

Eastern Chipmunk.—William Brewster, Cambridge Museum of Comparative Zoology.

Say's Chipmunk.—Edward R. Warren, Museum of Colorado College.

Flag Citelle.—Arthur H. Howell, Biological Survey.

Franklin Citelle.—Arthur H. Howell, Biological Survey.

Richardson Citelle.—Arthur H. Howell, Biological Survey.

Prairie-dog.—J. Stokley Ligon, Biological Survey.

Woodchuck.—Dr. Clyde Fisher, American Museum of Natural History.

Rockchuck.—Arthur H. Howell, Biological Survey.

Hoary Marmot.—J. Alden Loring, Owego, N. Y.

Southern Flying-squirrel.—Arthur H. Howell, Biological Survey.

Southern Flying-squirrel Habits.—Dr. Lillian D. Powers, White Plains

Northern Flying-squirrel.—Arthur H. Howell, Biological Survey.

Northern Flying-squirrel Habits.—Dr. Lillian D. Powers, White Plains.

Pocket-gopher.—Dr. C. Hart Merriam, Biological Survey.

Kangaroo-rat.—Vernon Bailey, Biological Survey.

Beaver.—Dr. Charles E. Johnson, Syracuse University.

Pack-rat.—Major Edward A. Goldman, Biological Survey.

Mountain Beaver.—Walter P. Taylor, Biological Survey.

Roundtailed Muskrat.—Dr. Francis Harper, Boston Society of Natural History.

Common Muskrat.—Olaus J. Murie, Biological Survey.

Porcupine.—Parke H. Struthers, Syracuse University.

Coney.—A. Brazier Howell, U. S. National Museum.

Prairie-hare.—Olaus J. Murie, Biological Survey.

Arctic Hare.—Dr. R. M. Anderson, National Museum of Canada.

Greenland Hare.—J. Dewey Soper, National Museum of Canada.

Snowshoe Rabbit.—Lee R. Dice, University of Michigan.

Blacktailed Jack.—Major Edward A. Goldman, Biological Survey.

Antelope-jack.—Dr. Edward W. Nelson, Biological Survey; and Dr. Charles T. Vorhies, University of Arizona.

Cottontail.—Dr. Hartley H. T. Jackson, Biological Survey.

Brush-rabbit.—Harold E. Anthony, American Museum of Natural History.

Swamp-rabbit.—Arthur H. Howell, Biological Survey.

Marsh-rabbit.—Arthur H. Howell, Biological Survey.

Pygmy Rabbit.—Harold E. Anthony, American Museum of Natural History.

Armadillo.—Vernon Bailey, Biological Survey.

Opossum.—Dr. Carl Hartman, Johns Hopkins University.

To Dr. James R. Walker, formerly of Pine Ridge Indian Reservation, I am indebted for the Sioux Indian names where used. For other Indian names, credit is given in the text.

To Dr. Henri M. Ami, of the Geological Survey, Ottawa, for a revision of the French-Canadian names used.

To William J. Tweddell, of Woonona, Man., and to my many Indian friends, for the Cree and Ojibway names.

To Dr. T. S. Palmer, of the Biological Survey, for help in many biographical details.

For essential assistance throughout, in research as well as in the literary and secretarial preparation of the text of this and the preceding three volumes, I am indebted to Mrs. Julia M. Buttree. The index itself, an exhaustive analysis and record, is entirely the product of her industry and devotion to the work.

ON GOING TO PRESS

It is now thirty years since I definitely set about producing this work. In 1898, I made the range maps, so far as the Horned Game is concerned; and since then, have carried them with me into every State of the Union and into nearly every Province of Canada, to get the best local information in making them correct.

The thirty leather-bound manuscript volumes on my shelves record my wanderings and my observations. The quotations from them throughout these Lives show that never once during that time did I lose sight of my ultimate goal.

In 1904, owing to attacks on the reliability of my animal stories as natural history, I was induced to offer a sample of my serious scientific work.

President Theodore Roosevelt had always been my friend and backer, and about this time he urged me to publish my observations. He said: "People do not dream of how many facts you have back of your stories." Although I was far from ready, it seemed wise to respond; so, in 1909, I published a preliminary of the present work, as Life Histories of Northern Animals.

This had the effect foretold by many friends—it silenced my critics.[1]

Meanwhile, I continued to gather material and experience, never doubting that in three or four years more, I should get out two additional volumes to cover the rest of the field. But the three or four years grew to be ten; and when, in 1919, I definitely abandoned all other pursuits to complete the present undertaking, allowing for it three full years, I was destined soon to realize that work done from 1900 to 1907 was now wholly out of date—far behind the swiftly moving times. All had to be rewritten, so that the work took nearly three times as long as was expected.

During this period, with from one to three secretaries steadily at work, I have written no other book, done little lecturing, taken no holidays, gone on no expeditions. My every day and every hour has been devoted to the one work; until now, after eight years, it is complete—text, maps, and illustrations all from my own hands.

---

[1] Among the appreciations sent to Seton by zoologists of high rank were the following:

"I regard your work as one of the most valuable contributions any naturalist has made to the life-histories of American mammals." (Theodore Roosevelt.)

Dr J. A. Allen said: "It is by far the best work ever-written on such a subject, as regards both text and illustrations."—The Publishers.

Nevertheless, the Biological Survey, the National Museum, and the American Museum have given me every help and every encouragement. The eminent men whose names are listed in the "Acknowledgments" have freely and cheerfully given me their best information and the benefit of their lifelong training as naturalists.

This, in effect, guarantees the authenticity of all facts submitted—a guarantee that, in its fullness and force, has never before been equalled in a popular natural history.

The question of a publisher was not easily settled. However, Messrs. Doubleday, Page & Company[1] agreed to issue the work first in an edition de luxe of 177 sets; then, in the more remote future a popular edition.

The 177 sets were sold before the first volume was printed, and a waiting list of would-be subscribers was a pleasant evidence of popular approval.

Now the last volume is finished and gone to press. I have had much joy (and some sorrow) in the production; but the reception accorded the first volume in 1925 (published June 19th) made me very happy. The second volume appeared in 1926 (November 12th); it was for this that the Council of the John Burroughs Memorial Association awarded me their medal of the year for the best contribution to natural history.

Volume III appeared on May 20, 1927; and this, the fourth and last, is to appear in the Spring of 1928.

I shall feel a sense of loss and desolation when this, my brain-child, is done and gone. I shall await with no little concern the verdict of the wise men—and with equal interest the opinion of the children.

There had been no attempt at a complete natural history of America's big Land Animals since the days of John Bachman, some eighty years agone. The time for a new one was ripe; I thought I heard the call.

A natural history must be a vast collection of reliable facts—plus a personality. The facts herein are the best available. Whether the personal touch they bear is acceptable, remains to be seen.

---

[1] Now Doubleday, Doran & Co., Inc.

THE SCOPE

VOLUME I

CATS, WOLVES, AND FOXES

VOLUME II

BEARS, RACCOONS, BADGER, SKUNKS, AND WEASELS

VOLUME III

DEER, ANTELOPE, BUFFALO, SHEEP, AND PECCARY

VOLUME IV

SQUIRRELS, RABBITS, ARMADILLO, AND OPOSSUM

CONTENTS—Vol. IV

SQUIRRELS, RABBITS, ARMADILLO, AND OPOSSUM

PAGE
Title Page iii
Copyright iv
Acknowledgments v
On Going to Press ix
The Scope of the Four Volumes xi
Contents of Volume IV xiii
Plates xv
Maps xix
Synoptics xxi
The Rodents 1
LXII. Gray-squirrel, *Sciurus carolinensis* Gmelin 7
LXIII. California Gray-squirrel, *Sciurus griseus* Ord 59
LXIV. Tasselear Squirrel, *Sciurus aberti* Woodhouse 67
LXV. Fox-squirrel, *Sciurus niger* Linnæus 81
LXVI. Apache Squirrel, *Sciurus apache* Allen 107
LXVII. Arizona Squirrel, *Sciurus arizonensis* Coues 111
LXVIII. Red-squirrel, *Sciurus hudsonicus* Erxleben 115
LXIX. Douglas Squirrel, *Sciurus douglasii* Bachman. 151
LXX. Fremont's Chickaree, *Sciurus fremonti* Audubon and Bachman 161
LXXI. Least Chipmunk, *Eutamias minimus* (Bachman). . . . 169
LXXII. Eastern Chipmunk, *Tamias striatus* (Linnæus) 183
LXXIII. Say's Chipmunk, *Callospermophilus lateralis* (Say) . . 217
LXXIV. Striped Ground-squirrel, *Citellus tridecemlineatus* (Mitchill) 227
LXXV. Franklin Ground-squirrel, *Citellus franklinii* (Sabine) . 249
LXXVI. Flickertail, *Citellus richardsonii* (Sabine) 259
LXXVII. Prairie-dog, *Cynomys ludovicianus* (Ord) 275
LXXVIII. Woodchuck, *Marmota monax* (Linnæus) 299
LXXIX. Rockchuck, *Marmota flaviventris* (Audubon and Bachman) 337
LXXX. Hoary Marmot, *Marmota caligata* (Eschscholtz) 351

PAGE

LXXXI. Little Flying-squirrel, *Glaucomys volans* (Linnæus) . 367
LXXXII. Big Flying-squirrel, *Glaucomys sabrinus* (Shaw) . . 385
LXXXIII. Pocket-gopher, *Thomomys talpoides* (Richardson) . . 395
LXXXIV. Kangaroo-rat, *Dipodomys deserti* Stephens 419
LXXXV. Beaver, *Castor canadensis* Kuhl 441
LXXXVI. Packrat, *Neotoma cinerea* (Ord) 503
LXXXVII. Mountain Beaver, *Aplodontia rufa* (Rafinesque) . . 525
LXXXVIII. Round-tailed Muskrat, *Neofiber alleni* True 557
LXXXIX. Common Muskrat, *Ondatra zibethica* (Linnæus) . . 567
XC. Porcupine, *Erethizon dorsatum* (Linnæus) 603
XCI. Coney, *Ochotona princeps* (Richardson) 635
XCII. Prairie-hare, *Lepus townsendii* Bachman 647
XCIII. Arctic Hare, *Lepus arcticus* Ross 667
XCIV. Greenland Hare, *Lepus groenlandicus* Rhoads . . . 681
XCV. Snowshoe Rabbit, *Lepus americanus* Erxleben . . . 699
XCVI. Blacktailed Jack, *Lepus californicus* Gray 735
XCVII. Antelope-jack, *Lepus alleni* Mearns 763
XCVIII. Cottontail, *Sylvilagus floridanus* (Allen) 779
XCIX. Brush Rabbit, *Sylvilagus bachmani* (Waterhouse) . . 817
C. Swamp-Rabbit, *Sylvilagus aquaticus* (Bachman) . . 821
CI. Marsh-Rabbit, *Sylvilagus palustris* (Bachman) . . 829
CII. Pygmy Rabbit, *Brachilagus idahoensis* (Merriam) . 839
CIII. Armadillo, *Dasypus novemcinctus* Linnæus 847
CIV. Opossum, *Didelphis virginiana* Kerr 865

SYNOPTIC INDEX OF VOLUME IV 899

PLATES

Those marked (L) are line cuts

The Forest Planter . . . . *Frontispiece*

PLATE		FACING PAGE
II.	Gray-squirrel Details (L)	22
III.	Gray-squirrel Nests and Tracks (L)	39
IV.	A Foster Mother	70
V.	Gray-squirrel Poses	71
VI.	Details of Western Gray-squirrel (L)	64
VII.	Details of Fox-squirrel (L)	97
VIII.	Red-squirrel	102
IX.	Details of Red-squirrel (L)	131
X.	Squirrel Storing Mushrooms	103
XI.	Red-squirrel Poses, etc. (L)	145
XII.	Red-squirrel Playing, etc. (L)	157
XIII.	Least Chipmunk Poses and Details (L)	178
XIV.	Eastern Chipmunk	134
XV.	Early Drawing of Chipmunk	135
XVI.	Poses of Common Chipmunk	166
XVII.	Mastology and Poses of Common Chipmunk (L)	203
XVIII.	The Demon of Murder	167
XIX.	Chipmunk's Den, Genitalia, and Cuterebra (L)	209
XX.	Chipmunks Singing to Sparrows	198
XXI.	Say's Chipmunk	199
XXII.	Skulls of Say's Chipmunk and Thirteen-striped Citellus (L)	236
XXIII.	Thirteen-striped Citellus	230
XXIV.	Details of Thirteen-striped Citellus (L)	245
XXV.	Franklin Ground-squirrel	231
XXVI.	Flickertail or Richardson Ground-squirrel	262
XXVII.	Runs and Burrow of Flickertail (L)	267
XXVIII.	Photographs of Prairie-dogs	263
XXIX.	Diagram of Prairie-dog Holes (L)	285

PLATE		FACING PAGE
XXIXa.	Prairie-dog Burrows (L)	290
XXX.	Skulls of Prairie-dog and Beaver (L)	293
XXXI.	Woodchuck and Trap	294
XXXII.	Tracks, Mastology, etc., of Woodchuck (L)	311
XXXIII.	Woodchuck Details (L)	317
XXXIV.	Woodchuck Mastology and Freak Teeth (L)	322
XXXV.	Plans of Woodchuck Burrows (L)	329
XXXVI.	Rockchucks at Home	295
XXXVII.	Details of Rockchuck (L)	346
XXXVIII.	Rockchuck Castles	358
XXXIX.	The Tribal Watchman	359
XL.	Details of Hoary Marmot (L)	362
XLI.	Flying-squirrels (L)	376
XLII.	Northern Flying-squirrel	390
XLIII.	Pocket-gopher	391
XLIV.	Life Studies of Pocket-gopher (L)	403
XLV.	Burrows, etc., of Gopher (L)	406
XLVI.	Residential Burrow of Gopher (L)	409
XLVII.	Earthworks of Gopher (L)	411
XLVIII.	Mounds, etc., of Gopher (L)	415
XLIX.	Kangaroo-rat	422
L.	Packrat of the Rocky Mountains	422
LI.	Details of Dipo (L)	432
LII.	Big Kangaroo-rat Burrows, etc. (L)	435
LIII.	Family of Beavers	423
LIV.	Feet of Beaver (L)	456
LV.	Yancey Beaver Ponds (L)	468
LVI.	Views of Yancey Beaver Ponds (L)	464
LVII.	Beaver Canals (L)	468
LVIII.	Beaver Works (L)	479
LIX.	Beaver Poses and Details (L)	486
LX.	Chips and Splashes (L)	492
LXI.	Beavers in Winnipeg Zoo	454
LXII.	Old Print of Beavers	455
LXIII.	Skulls, etc., of Neotoma (L)	509
LXIV.	Florida Rat	578
LXV.	Nests of Neotoma (L)	514
LXVI.	Mountain Beaver in the Elk-brake	546
LXVII.	Mountain Beaver, to illustrate Whiskers	547
LXVIII.	Mountain Beaver (dead)	547

PLATE		FACING PAGE
LXIX.	Burrows of Mountain Beaver (L)	546
LXX.	Details of Muskrat Anatomy (L)	573
LXXI.	Muskrat Den (L)	579
LXXII.	Details of Muskrat House, and Scatology (L)	589
LXXIII.	Tracks of Muskrat (L)	595
LXXIV.	Porcupine at Home	610
LXXV.	Porcupine Details (L)	619
LXXVI.	Photographs of Porcupines	611
LXXVII.	Lynx Making a Mistake	579
LXXVIII.	Scatology of Certain Rodents (L)	631
LXXIX.	Conies and Their Hay	642
LXXX.	Coney Haybarns	643
LXXXI.	Attitudes and Details of Coney (L)	645
LXXXII.	Prairie-hare	650
LXXXIII.	Life Studies of Prairie-hare (L)	655
LXXXIV.	Feet of Prairie-hare (L)	659
LXXXV.	Prairie-hare Poses	651
LXXXVI.	Head of Arctic Hare (L)	672
LXXXVII.	Feet of Arctic Hare (L)	676
LXXXVIII.	Skulls of Hares (L)	693
LXXXIX.	Snowshoe Rabbit in Summer Coat	666
XC.	Photograph of Snowshoe Rabbit	667
XCI.	Ebb and Flow of Rabbits and Their Enemies (L)	711
XCII.	Snowshoe Rabbits Photographs	674
XCIII.	Details of Snowshoe Rabbit (L)	719
XCIV.	Snowshoe Rabbits, Young, and Enemy	675
XCV.	Snowshoe Rabbit Poses (L)	731
XCVI.	Portrait of a Jackrabbit	706
XCVII.	A California Rabbit Drive	707
XCVIII.	Tracks, etc., of Rabbits (L)	750
XCIX.	Various Rabbits' Ears and Tails (L)	756
C.	Rabbit Studies	738
CI.	Ear of Antelope-jack (L)	771
CII.	Details of Antelope-jack (L)	777
CIII.	Cottontail Studies	739
CIV.	Cottontail Tracks and Young	770
CV.	Details of Cottontail (L)	805
CVI.	Horned Cottontails (L)	811
CVII.	Pygmy Rabbit of Idaho	771
CVIII.	Texan Armadillo (L)	859

PLATE FACING PAGE
CIX. Possum Up a Tree 882
CX. Possum Poses 883
CXI. Details of Possum (L) 883
CXII. Paws of Possum (L) 886
CXIII. Various Scats (L). 891

MAPS

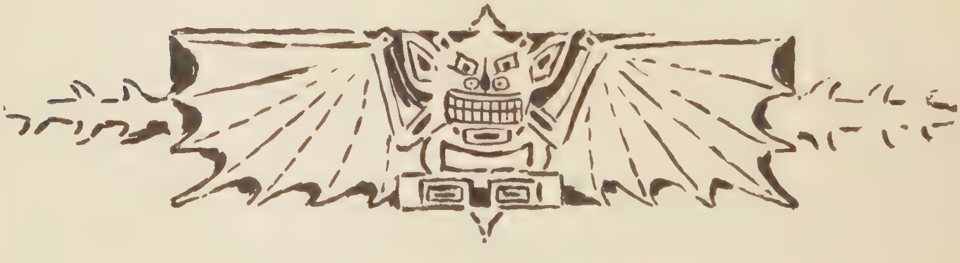
PAGE

I. Range of the Graysquirrel, of the Tasselear Squirrel, and of the California Gray-squirrel 12
II. Range of the Fox-squirrel, of the Apache Squirrel, of the Arizona Squirrel, and of the Mountain Beaver . . . 85
III. Range of the Red-squirrel, of Fremont's Squirrel, and of the Douglas Squirrel 164
IV. Forest Regions of the United States in 1919 174
V. Range of the Eastern Chipmunk, and of the Least Chipmunk 186
VI. Range of the Thirteen-striped Citellus 230
VII. Range of the Franklin Ground-squirrel, and of Say's Chipmunk 252
VIII. Range of the Flickertail 262
IX. Range of the Hoary Marmot, of the Prairie-dog, and of the Kangaroo-rat 279
X. Range of the Woodchuck, of the Rockchuck, and of the Armadillo 341
XI. Range of the Flying-squirrels 370
XII. Range of the Pocket-gophers 399
XIII. Range of the Beaver 446
XIV. Range of the Packrat 507
XV. Range of the Common Muskrat, and of the Round-tailed Muskrat 560
XVI. Range of the Porcupines, of the Pygmy Rabbit, of the Brush Rabbit, and of the Antelope-jacks 607
XVII. Range of the Conies, and of the Opossum 639
XVIII. Range of the Greenland Hare, of the Arctic Hare, of the Prairie-hare, of the Marsh Rabbit, and of the Swamp Rabbit 684
XIX. Range of the Snowshoe Rabbit, and of the Blacktailed Jack 739
XX. Range of the Cottontail 785

SYNOPTIC LINE DRAWINGS

PAGE
Graysquirrel Fluffing His Tail 8
Western Graysquirrel Escaping the Hawk 59
Tassel-ear Squirrel 67
Tassel-ear's Nest 79
Fox-squirrel 81
Squirrel in Robe 106
Apache Squirrel 107
Arizona Squirrel 111
And Sometimes 114
Redsquirrel in a Tantrum 116
Douglas Squirrel—Harvest Time 151
A Study in Tracks 159
Fremont's Squirrel—Courage 161
Little Chipmunk, a Birdy-beast 169
Eastern Chipmunk—Spring 183
Say's Chipmunk—The Calicochip 217
Mother Carey 225
Flag Citelle 227
Franklin Ground-squirrel—Good-bye 249
Richardson Ground-squirrel—The Short Cut to School 259
Prairie-dog—The Happy Family 275
Sun Worshipper 298
Woodchuck—The Seven Sleepers 299
Rockchuck—King of the Castle 337
Hoary Marmot—The Whistler of the Peaks 351
Northern Flying-squirrel—A Theory 385
Pocket-gopher and the Rocky Mountains 418
Dipo at His Door 419
The Desert 440
The Beaver's Trowel 442
Beavers Cutting Tree 501
Packrat 503
Packrat Enjoying His Collection 523

PAGE
Mountain Beaver—The Engineers 525
Round-tailed Muskrat 557
Common Muskrat—The Hoofed Muskrat 568
Pa Porky 602
Porcupine—Go Ahead—Strike! 603
Dog Retiring 633
Coney Restaurant 635
The Night Alarm 646
Prairie-hare 647
European Hare—The Welsh Rabbit 666
Arctic Hare in the Gloom 667
Greenland Hare—The Snowy Kangaroo 681
Snowshoe Rabbit 699
Dancing Rabbits 734
Blacktailed Jackrabbit—The Spy Hop 735
Antelope Jackrabbit—The Long and the Short of It 763
Cottontail—Molly Freezing 780
Cat and Cottontail 815
Brush Rabbit Multiplying 817
Swamp-rabbit 821
Marsh-rabbit 829
Cottontail and Stone 837
Pygmy Rabbit—A Fair Fight 839
Cougar and Rabbit 845
Elk Duels 846
Armadillo 847
Impressionist Drawing of Armadillo 863
Opossum 865
Map of U. S. in 1950 897



LIVES
OF
GAME ANIMALS

Volume IV

Order Rodentia, etc.
SQUIRRELS, RABBITS, ARMADILLO, AND OPOSSUM

ORDER RODENTIA OR RODENTS

Mostly small animals, the largest in North America being the Beaver. In general, of mouselike or rabbitlike appearance. Clad in fur. Tail extremely variant. But all distinguished by the absence of canines, and the conspicuous development of 2 incisors or gnawing teeth in each jaw.

1. Family Sciuridæ or Squirrels and Marmots

Rodents with short ears, and bushy tails (usually long); lower grinders, 4 on each side.

Genus *Sciurus* Linnæus. Small rodents of tree-climbing habits; they have large and very bushy tails, moderate ears, no cheek pouches, four fingers and a knoblike thumb on the fore feet; and five nearly equal toes on the hind. Teeth as follows:

$$\text{Inc. } \frac{1-1}{1-1}\text{; prem. } \frac{2-2}{1-1} \text{ or } \frac{1-1}{1-1}\text{; mol. } \frac{3-3}{3-3} = 20 \text{ or } 22$$

Genus *Citellus* Oken. Squirrel-like animals that live on the ground. Outer ear various, from almost none to medium. Well-developed cheek pouches. Five nearly equal toes on hind foot; 4 fingers and a knoblike thumb in front. Teeth as follows:

$$\text{Inc. } \frac{1-1}{1-1}\text{; prem. } \frac{2-2}{1-1}\text{; mol. } \frac{3-3}{3-3} = 22$$

Genus *Tamias* Illiger. Small Squirrels, living on the ground. Well-developed cheek pouches. Along the back, a series of black stripes on their brown or gray fur. Teeth as follows:

$$\text{Inc. } \frac{1-1}{1-1}\text{; prem. } \frac{1-1}{1-1}\text{; mol. } \frac{3-3}{3-3} = 20$$

Genus *Eutamias* Trouessart. Chipmunks that differ most visibly from those of the genus *Tamias* in being much smaller and paler. Longer tails, and 2 more premolars. Teeth as in *Citellus*.

Genus *Callospermophillus* Merriam. Squirrels that live chiefly on the ground. Squirrel-like form; but the tail, which is bushy, is only half the length of head and body. Cheek pouches. Conspicuous stripes along the body. Ears come between those of the Chipmunks (which have long ears) and those of the Ground-squirrels of the *Citellus* group (which have short ears). Teeth as in *Citellus.*

Genus *Cynomys* Rafinesque. Squirrel-like rodents of terrestrial habits. Five distinct claws on each foot. Rudimentary cheek pouches. Tail and ears very short. Molars very large. Teeth as in *Citellus.*

Genus *Marmota* Frisch. Large rodents that have the following characters: form, stout; tail, short and bushy; ears, very short; thumb on front paws a mere knob with a nail; the other 4 fingers with claws; 5 well-developed toes on hind feet; very small cheek pouches; teeth as in *Citellus.*

Genus *Glaucomys* Thomas. Nocturnal, Squirrel-like animals, with large eyes and ears. Clad in very soft, velvety fur, with tail flat horizontally, and with a flying membrane between the fore leg and the hind leg on each side, supported and enlarged by a spur developed from the pisiform bone. Teeth as in *Citellus.*

2. FAMILY GEOMYIDÆ OR MOLE-GOPHERS

Rodents about the size of a Rat; they live the life of a Mole, digging and dwelling in underground galleries. Their fur is soft and fine, but dull gray or brown, without conspicuous markings. Their eyes and ears are very small. Front feet, enormously developed for digging; their thumb, a mere knob with a nail. Tails, short, nearly naked, and developed as organs of touch. In each cheek, an enormous fur-lined pocket or pouch, that opens in front outside of the mouth.

Genus *Thomomys* Wied. As above, with smooth incisors; also front upper teeth without a central groove. Teeth as follows:

$$\text{Inc. } \frac{1-1}{1-1}\text{; prem. } \frac{1-1}{1-1}\text{; mol. } \frac{3-3}{3-3} = 20$$

3. FAMILY HETEROMYIDÆ OR POCKET JUMPING-MICE

Mouselike rodents with long tails and hind feet; toes four or five; well-developed cheek pouches; fur soft.

Genus *Dipodomys* Gray. Soft brown or gray fur, with white under parts; no spots or stripes; very small fore feet, and very large and long hind feet with but 4 toes; tail, very long and strong; ears, large and round; eyes, big and bright; cheek pouches well-developed. Teeth as follows:

$$\text{Inc. } \frac{1-1}{1-1}\text{; mol. } \frac{3-3}{3-3} = 16$$

4. FAMILY CASTORIDÆ OR BEAVER

Very large rodents of aquatic habits. Massive skull of general squirrel type. Short ears. Five toes on each foot; the hind foot webbed; the claw of the second toe on hind foot, double; tail, broad, flat horizontally, and scaly; incisors, of a deep orange colour. Teeth as follows:

$$\text{Inc. } \frac{1-1}{1-1}\text{; prem. } \frac{1-1}{1-1}\text{; mol. } \frac{3-3}{3-3} = 20$$

Genus *Castor* Linnæus. As above.

5. FAMILY CRICETIDÆ OR AMERICAN MICE

Mouse or ratlike animals with tails extremely variant. Teeth more simple than in the Old World *Muridæ*.

Genus *Neotoma* Say and Ord. As above, with more or less hairy tails, and teeth as follows:

$$\text{Inc. } \frac{1-1}{1-1}\text{; mol. } \frac{3-3}{3-3} = 16$$

Genus *Neofiber* True. To all intents and purposes, a large Field-mouse, differing from *Microtus* chiefly in size. Skull, dentition, and fur are much like those of *Ondatra*, which is simply a large edition of *Microtus*. But *Neofiber* differs from *Ondatra* and resembles *Microtus* in having the tail round.

Genus *Ondatra* Link. Simply huge Meadow-mice, with naked tails flattened on the sides. Teeth as in *Neotoma*.

6. FAMILY APLODONTIIDÆ OR MOUNTAIN BEAVER

Rodents the size of a small Woodchuck or a Rabbit, with short legs, thick bodies, short ears of almost human shape, and a tail so short that it does not stick out beyond the fur. Five toes on each foot; but the inmost toe on the front foot is a mere stump which, however, acts as a pusher. Long digging claws, 6 mammæ, and teeth as follows:

$$\text{Inc. } \frac{1-1}{1-1}\text{; prem. } \frac{2-2}{1-1}\text{; mol. } \frac{3-3}{3-3} = 22$$

Genus *Aplodontia* Richardson. As above.

7. Family Erethizontidæ or Porcupines

Thick-set, short-faced, large rodents. Lips, all hairy; head and body covered on back and sides with long, sharp spines; tail, well-developed and spiny above; short ears; 4 toes on fore feet; 5 on hind feet; 4 mammæ, all pectoral.

Genus *Erethizon* F. Cuvier. As above, but tail short, thick, spiny above. Teeth as follows:

$$\text{Inc. } \frac{1-1}{1-1};\ \text{prem. } \frac{1-1}{1-1};\ \text{mol. } \frac{3-3}{3-3} = 20$$

ORDER LAGOMORPHA OR RABBITS

As Rodentia, but tail small or rudimentary, and upper incisors 4.

1. Family Ochotonidæ or Pikas

Small animals, each the size of a half-grown Rabbit, but presenting a combination of Mouse and Rabbit characters. The teeth are, in some respects, mouselike; the general form is rabbitlike. The external tail is wholly absent, which is a Rabbit feature pushed to the limit. The molars are rootless, as in some Mice. The soles of the feet are hairy, which is rabbitlike. The ears are round and short, which is mouselike.

Genus *Ochotona* Link. As above. Teeth as follows:

$$\text{Inc. } \frac{2-2}{1-1};\ \text{prem. } \frac{3-3}{2-2};\ \text{mol. } \frac{2-2}{3-3} = 26$$

2. Family Leporidæ or Rabbits

Large, terrestrial rodents with soft, dense fur, very long ears, long hind legs, short, bushy tails, and a remarkable duplication of the upper incisors —that is, behind the usual 2 in front of the upper jaw, is a rudimentary pair.

Genus *Lepus* Linnæus. Rabbitlike animals of large size, covered with soft fur and under-wool, never definitely spotted or striped. The Northern species turn pure white in winter. Long ears and legs; tail, medium or short; interior of mouth and soles of feet, hairy; fore feet with 5 toes, hind with 4; mammæ 6 to 10. Teeth as follows:

$$\text{Inc. } \frac{2-2}{1-1};\ \text{prem. } \frac{3-3}{2-2};\ \text{mol. } \frac{3-3}{3-3} = 28$$

Genus *Sylvilagus* Gray. Rabbits and Hares whose young are born blind, naked and helpless, to be nursed in a nest for a week or more before able to see and run. Many peculiarities of skull and of bony framework. All show the peculiar Cottontail pattern.

Genus *Brachylagus* Miller. Distinguished from *Sylvilagus* by being much smaller; and by a general shortness.

ORDER EDENTATA (XENARTHRA) OR SLOTHS, ARMADILLOS, AND ANT-EATERS

Animals of varied form; but all agree in the absence of incisors, or, indeed, of any teeth in the fore part of the jaws.

FAMILY DASYPODIDÆ OR ARMADILLOS

Body covered with a bony carapace, with 7 to 9 movable ring-joints around the middle; a long pointed snout; long ears; long tail, with scaly rings; front feet with 4 toes, hind with 5, all with strong, slightly curved claws. Teeth as follows:

$$\text{Inc. } \frac{0-0}{0-0};\ \text{can. } \frac{0-0}{0-0};\ \text{mol. } \frac{8-8}{8-8} \text{ or } \frac{7-7}{7-7} = 32 \text{ or } 28$$

Genus *Dasypus* Linnæus. As for Family.

ORDER MARSUPIALIA OR POUCHED ANIMALS

Of various sizes, clad in hair or fur. Tail well developed. Particularly distinguished by lack of placenta, and the presence of a pouch for carrying the young.

FAMILY DIDELPHIDÆ OR OPOSSUMS

Marsupials of small size. Furry creatures, with short limbs, 5 toes on each foot; naked, prehensile tail; and a pouch to carry the young. They are of arboreal habits. All belong to America.

Genus *Didelphis* Linnæus. In addition to the Family characteristics, it has the following: Toes, all with claws, except the thumb on the hind foot; incisors, small and pointed; canines, large; premolars, with compressed pointed crowns. Teeth as follows:

$$\text{Inc. } \frac{5-5}{4-4};\ \text{can. } \frac{1-1}{1-1};\ \text{prem. } \frac{3-3}{3-3};\ \text{mol. } \frac{4-4}{4-4} = 50$$

LIFE LXII—GRAY-SQUIRREL

PAGE
Names 9
Description: Size, Weight, Colour, Black Squirrels or Melanos, Albinos, Change of Coat 9
Races 10
Range and Outlying Records 11
Haunts 13
Home Range 13
The Myriad Migrations 14
After the Trek 15
Early Records of These Marchings 16
Movements Since 1870 18
Causes of the Migrations 19
The Lemming Parallel 20
Numbers Ancient 21
The Desolation 24
The New Day 25
Their Last Stronghold 26
Fanitasho's Fare 28
His Favourite Food 29
Storage 30
The Forest Planter 32
Drink 34
An Evil Appetite 34
Sociability and Games 34
Hibernant 35
His Tail 36
Powers—Speed and Jumping 38
Track, Dung, and Sanitation 38
Intercommunication 40
Song 41
Mating 42
Nesting 43
Gestation and Young 44
End of the Blind Period 44

PAGE
Nesting Notes 44
Care of the Young 46
His Way of Life 47
The Gray-back's Tricks 49
Habits in Captivity 50
Enemies 51
Insect Parasites 53
The Silver Storm 56
Age 56
Service to Man 56

References 58

Gray-squirrel, Black-squirrel, Migratory Squirrel, Bannertail, Silvertail, Grayback, Mishannek, Fanitasho

Sciurus carolinensis Gmelin

(L. *Sciurus*, from Greek *Skia*, shadow, *oura* tail, that is, the creature that sits in the shadow of its tail; L. *carolinensis*, of Carolina)

Sciurus carolinensis GMELIN, 1788; Syst. Nat., I, p. 148.

TYPE LOCALITY—"Carolina"

FRENCH CANADIAN, *l'Écureil gris et noir.*
OJIBWAY, *Kitchi-adjidamo.*
NATICK, *Mishe-anequs; Mishannek* (Trumbull).
CHOCTAW, *Fani Okchako; Fanitasho* (Byington).

The Family *Sciuridæ* may be recognized among North American mammals, as rodents with short ears, and bushy tails (usually long): lower grinders, 4 on each side.

The genus *Sciurus* (Linnæus, 1758) comprises small rodents of tree-climbing habits; they have large and very bushy tails, moderate ears, no cheek pouches, four fingers and a knob-like thumb on the fore feet, and five nearly equal toes on the hind. The teeth are:

$$\text{Inc. } \frac{1-1}{1-1}\text{; prem. } \frac{2-2}{1-1} \text{ or } \frac{1-1}{1-1}\text{; mol. } \frac{3-3}{3-3} = 20 \text{ or } 22$$

When seen in the tree-tops, its gray (or, in the North, its black) colour, and immense, bushy tail, are distinguishing marks. From the Fox-squirrel, it is easily told by its smaller size, white under-parts and the white edging of the tail; and from the Red-squirrel, by its greater size, gray colour, and white-edged tail.

To the generic characters, it adds the following:

Size. Total length, 19 in. (482 mm.); tail, 8½ in. (216 mm.); hind foot, 2⅝ in. (66 mm.). Its dentition differs from that of the Fox-squirrel in having an extra, though insignificant, front premolar on each side of the upper jaw.

Weight. About one pound. A fine ♀ taken at Greenwich, Conn., Sept. 29, 1921, weighed 1 lb., 3½ oz.; another taken there Nov. 17, 1924, weighed 1 lb., 4 oz. Vernon Bailey records 1 lb., 7 oz. and 1 lb., 8 oz., for Washington, D. C., adult females.[1] The average weight of 63,120 taken in Pennsylvania in 1921, was only 1 lb;[2] but the greater number of these were, of course, young of the year.

Colour. General colour, pepper-and-salt gray, the underfur being lead colour, and each of the over-hairs leaden at base, then buff, then blackish, and at the tip, white; on the head, back, paws, and saddle down the back, the gray is tinged with rusty yellow. The cheeks, muzzle, ears, and upper parts of paws, are often nearly clear tan or sienna; chin, throat, underside of legs, and all below, clear white. The long tail hairs are of the same style as those on the body, i.e., basal half, tan; next quarter, black; tip, white.

Black Squirrels or Melanos. One of the most remarkable colour variations is the black or melanistic phase of this Squirrel. Sometimes it is of one glossy black all over, but also showing in the same region, all shades of gradation between black and gray. The Blacks seem to be found only in the northern parts of the range. In Minnesota, about half are black. Melanism increases in frequency northward, until in Canada, the black is the rule; there, at most, 5 per cent. are gray.

Black or gray, however, it is the same species, and often from the same nest.

Albinos. White or albino Gray-squirrels are occasionally found in all parts of the range. R. S. Mebane, of Great Falls, S. C., tells me (1916) that there is a colony of about 100 Gray-squirrels at Greenwood, N. C.; all are white with pink eyes. They have been known for 22 years. They live on 25 acres.

Change of Coat. In winter, the tan colour is less in extent, and the general appearance is more of a silvery gray. The fur also is longer and fuller; on the ears, it forms a projecting fringe at this time.

Races

Five races have been recognized:

carolinensis Gmelin, the typical form. T. l., "Carolina."

leucotis Gapper, much larger, and of more silvery gray. T. l., between Toronto and Lake Simcoe, Ont., i.e., Richmond Hill.

---

[1] Mamm. Dist. Col., p. 108.

[2] Game Rept.

hypophaeus Merriam, same size as foregoing, but darker on the back, and with very little white below. T. l., Elk River, Minn.

fuliginosus Bachman, larger than the type, of dark rich colours, never white below, often reddish. T. l., near New Orleans, La.

extimus Bangs, very small and pale gray; tail short. T. l., Miami, Fla.

RANGE AND OUTLYING RECORDS

Map I (p. 12) sets forth its range; and its division into races corresponds closely with the faunal areas covered by the species. It is a nut-eating animal, and its habitat coincides with that of the oaks and hickories, especially the black oak, white oak, and bitternut hickory. Where these most abound, the Gray-squirrel is thickest; while solid pine forests are little to its liking, and practically devoid of the species.

In 1908, when at Duluth, Minn., I learned from the local taxidermist, T. J. Storey, that both black and gray forms are found there, but are very rare.

Richardson describes a black specimen from Fort William on the north shore of Lake Superior, and says: "It is not an uncommon inhabitant of the northern shores of Lakes Huron and Superior."[3]

"A few occurred near Gogebic Lake [North Michigan]."[4]

When I was camping in Algoma in 1904, the Indians told me that it was quite unknown there; and the white hunters made similar statements. The same applies to Nipissing Lake region.

In 1910, while at Pembroke, Ont., I was shown by Dr. G. H. Belaire, a black Squirrel, killed one mile west of the town in Nov., 1909. Two others he said were taken about 1904, but the species is very rare there.

In the Museum of the Geological Survey, Ottawa, Canada, is a black specimen from Beaumaris, Ont.; and a gray from Namur, Labelle Co., Que. P. A. Taverner tells me that he has seen a specimen (black) taken at Carp, Ont., and two specimens taken in Muskoka; also that the species is fairly common around Smith's Falls, on Rideau River. Thus, its extension in Canada corresponds closely with that of bitternut and white oak.

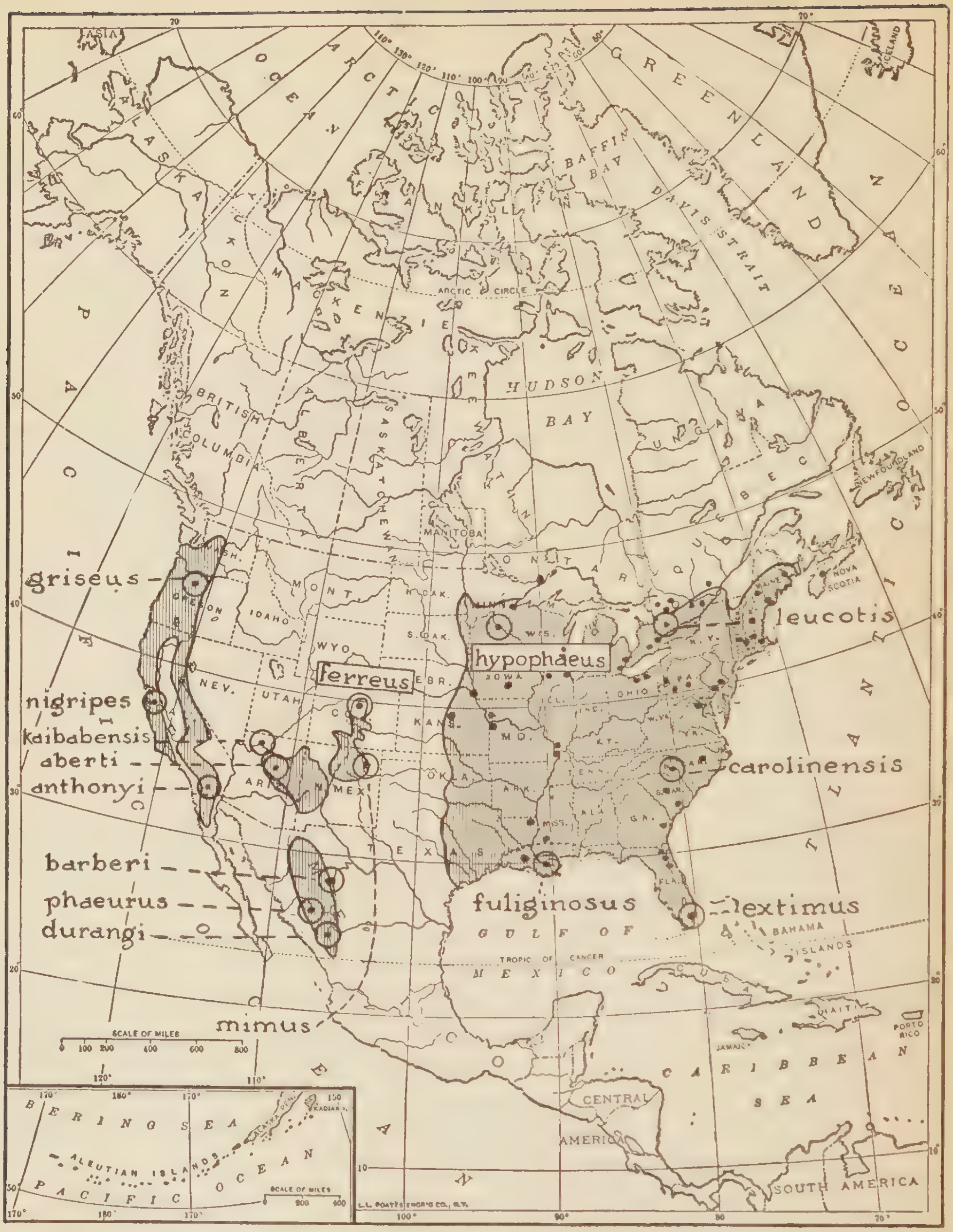
In New Brunswick, "a few have been observed in Charlotte and Carleton counties, near the western border."[5] Some Gray-squirrels at Frederic-

---

[3] F. B. A., I, 1829, p. 191.

[4] Dice and Sherman, Mus. Zool. Univ. Mich., Feb. 25, 1922, p. 38.

[5] Mamm. of N. B., Chamberlain, 1892, p. 32.



MAP I.—RANGE OF THE GRAY-SQUIRREL, OF THE TASSELEAR SQUIRREL, AND OF THE CALIFORNIA GRAY-SQUIRREL

By E. T. Seton, with assistance of the Biological Survey, 1927

ton, N. B., probably introduced, are told of by Mrs. Nathan C. Squires.[6]

In Nova Scotia, the species has three times been taken. All are recorded in the Trans. of the N. S. Inst. of Nat. Sci., as follows: "A large Black Squirrel . . . was given me from Cumberland."[7] "One shot about the middle of July, 1890, at 'The Gore,' Hants Co., N. S., by Mr. McDonald."[8] "One shot May 20, 1894, near the old sugar refinery, western side of the northwest arm, Halifax."[9]

From Hinckley, Me., G. W. Hinckley writes that Gray-Squirrels were rare there, but that there were two or three on the west bank of the Kennebec River.[10]

In 1896, Bangs described the long-overlooked Everglade Gray-squirrel, which completed the accredited range of the species over the whole of the Atlantic States.[11]

HAUNTS

When compared with its near kinsman, the Fox-squirrel, we find that the Gray-squirrel is a creature of the dense bottomland woods, where nut trees and heavy shade abound; whereas the Fox-squirrel is the hill-squirrel —he prefers the high ridges and the more open groves or borderlands. In the regions where the Red-squirrel and the Gray-squirrel overlap, the former is found chiefly in coniferous woods and high grounds; while the latter seeks the hardwoods and the best shelters from the wind.

But the Gray-squirrel is essentially a creature of the big timber. It cannot live like the Red-squirrel in a thicket of saplings, nor maintain itself in the line of trees along a fence. Unlike the Red-squirrel, it does not know the safety of a burrow; even in dire extremity, I never knew a Gray-squirrel seek refuge underground.

HOME RANGE

What is the home range of the individual? On this, I have but little evidence. On my grounds, is a pair that frequently come 200 yards to the house for certain red oak acorns that seem to please them. Farther than the house would be out of the woods, so that does not prove much. In the winter, the same pair roams in a circle of half a mile across.

---

[6] Can. Field Nat., October, 1924, pp. 158–59.

[7] Gilpin, Pt. III, 1872, p. 125.

[8] H. Piers, VII, Pt. 4, 1890, p. 467.

[9] Harry Piers, IX, 1897, p. 255.

[10] Forest & Stream, Oct. 7, 1911, p. 557.

[11] Review, p. 158.

The Gray-squirrels in several city parks that I know, seem satisfied to keep within the three or four acres of the park; but these are not normal conditions.

Judging from other cases, and from the tracks in the snow, I think a Gray-squirrel will gladly live his life wholly within a 100-acre wood lot. But it is not yet proven.

THE MYRIAD MIGRATIONS

In all the early natural histories, this Squirrel is called "migratory," and amazing accounts are given of its armies appearing to devastate the farms of whole regions. These remarks apply to this and none other of our Squirrels.

Let us first visualize this phenomenon through the eyes of those who saw it more than once.

I have found no living man recently who was privileged to be an eye-witness, and could describe it; I doubt if one of these great treks took place after 1870. So we must rest content with a compilation from two rambling accounts by the naturalists, Robert Kennicott, and Dr. John Bachman, who many times saw the great outpourings of the Squirrel flood.

"The most interesting feature in the habits of this animal," says Kennicott, "is the remarkable migration performed at times by large bodies of them. . . . Immense numbers congregate in autumn, and move off together, continuing their progress in the same general direction, whatever it may be [nearly all recorded moved easterly, one only south, and one north], not even turning aside for large streams. . . .

"They moved along rather leisurely, stopping to feed in the fields, and upon the abundant nuts and acorns of the forests. So far had they departed from their accustomed habits, that they were seen on the prairie, four or five miles from any timber; but even there, as usual, they disliked to travel on the ground, and ran along the fences wherever it was possible."[12]

"The farmers in the Western wilds," says Bachman, "regard them with sensations which may be compared to the anxious apprehensions of the Eastern nations at the flight of the devouring locust. At such periods, which usually occur in autumn, the Squirrels congregate in different districts of the far Northwest; and in irregular troops, bend their way instinctively in an eastern direction. Mountains, cleared fields, the narrow bays of some of our lakes, or our broad rivers, present no unconquerable impediments. Onward they come, devouring on their way everything that is suited to their taste, laying waste the corn and wheatfields of the farmer; and as their numbers are thinned by the gun, the Dog, and the club, others fall in and fill up the ranks, till they occasion infinite mischief, and call forth more than empty threats of vengeance."[13]

---

[12] Quads. Ill., pp. 64–65.

"Ordinarily averse to entering the water, they now take to it boldly, and, though swimming with difficulty, manage to cross broad rivers, like the Niagara and the Ohio, though many are drowned in the attempt. . . .

"Sometimes, when on these migrations, especially after crossing rivers, the Squirrels become so fatigued as to be easily captured, and thousands are then killed by boys, armed merely with sticks and stones. I learn from Dr. John A. Kennicott that, during one of these migrations, innumerable Squirrels swam across the river Niagara and landed near Buffalo, New York, in such a state of exhaustion that the boys caught them in their hands, or knocked them from the fences and bushes with poles."[14]

"They swam the Hudson in various places between Waterford and Saratoga; those which we observed crossing the river, were swimming deep and awkwardly, their bodies and tails wholly submerged; several that had been drowned were carried downwards by the stream, and those which were so fortunate as to reach the opposite bank, were so wet and fatigued, that the boys stationed there with clubs found no difficulty in securing them alive, or in killing them. Their migrations on that occasion did not, as far as we could learn, extend farther eastward than the mountains of Vermont; many remained in the county of Rensselaer, and it was remarked that for several years afterwards Squirrels were far more numerous there than before. It is doubtful whether any ever return to the West, as finding forests and food suited to their taste and habits, they take up their permanent residence in their newly explored country, where they remain and propagate their species, until they are gradually thinned off by the increase of inhabitants, new clearings, and the dexterity of the sportsmen around them."[15]

AFTER THE TREK

"After one of these grand migrations, very few of the species are found in the localities from which they have moved, and these, as if alarmed at the unusual solitude, are silent and shy. They rapidly increase in numbers, however, and in a few years, are as abundant as before. I am not aware that they ever migrate except when exceedingly abundant. Of these immense hordes, but few probably survive. No sudden increase in their numbers was heard of in southern Wisconsin after the several migrations from northern

---

[13] Q. N. A., I, p. 271.

[14] Quads. Ill., p. 64.

[15] Q. N. A., I, p. 272.

Illinois. Many are drowned in attempting to cross streams, as has been stated; not a few are destroyed by man; some die from utter exhaustion; and, when thus forced to travel, in an unnatural manner, upon the ground, they fall an easy prey to rapacious birds and mammals, all of which feast when the Squirrels migrate."[16]

EARLY RECORDS OF THESE MARCHINGS

These migrations are now a thing of the past. The conditions that created them are gone forever. We can but find historian joy in piecing together the fragmentary accounts and passing comments that tell how often they came, and how, and when. There are not many of them recorded; and those notices that exist are commonly deficient in not stating the direction or extent of the migration. The earliest I find is in Kalm's "Travels," 1770, p. 316. He speaks of a Squirrel migration from the mountains to the lowlands of eastern Pennsylvania in 1749.

Dr. Bachman states that, in the autumn of 1808 or 1809, great hordes came from the West into northern New York and Vermont; and of yet another migration in 1819 on the Ohio, 100 miles below Cincinnati, when for about 130 miles, he saw "a large number of Squirrels swimming across the river . . . strewed, as it were, over the surface of the water."[17] This is the only available note that indicates the width of the migrating army.

Dr. John D. Godman, discussing the Gray-squirrel migration, says: "While travelling through the State of Ohio, in the autumn of 1822, we had an opportunity of witnessing something of this sort. Parts of the country appeared to swarm with Squirrels, which were so numerous that, in travelling along the high road, they might be seen scampering in every direction; the woods and fields might be truly said in the country phrase to be 'alive with them.' . . .

"We found the Squirrels in 1822 most numerous throughout the country lying between the Great and Little Miami River [20 miles]; they became evidently fewer as we advanced toward Chillicothe, and beyond that place, were so rare as to be seldom seen."[18]

"Dr. S. P. Hildreth[19] quotes from the manuscript of Col. James Barker, of the Gray-squirrel 'coming in millions from the North to the South, destroying whole fields of corn in a few days.'"[20]

---

[16] Quads. Ill., pp. 64–65.

[17] Q. N. A., I, p. 272.

[18] Am. Nat. Hist., I, pp. 344–45.

[19] Pioneer History of the Ohio Valley, 1848.

[20] Mamm. Ohio, A. W. Brayton, 1882, p. 110.

Kennicott mentions, without date, a migration from Canada across the Niagara River into western New York.[21]

Dr. Asa Fitch refers to 1857 as a "Squirrel year" about Lakeville, in New York State.[22]

The best observations are by Dr. P. R. Hoy, of Racine, Wis. He witnessed a great migration of Squirrels from Wisconsin southwest for 4 weeks in the early autumn of 1842, and again in 1847, and 1852; and foretold one in 1857.[23]

In Sept., 1859, there was a great southward migration of Squirrels in McKean Co., Pa., according to C. W. Dickinson of Smethport, Pa. There had been 16 degrees of frost in the June of that year—the worst ever recorded; there were neither nuts nor berries in the woods; and the Squirrels, practically all Blacks, moved out in thousands. Very few remained, and they were thin. The migration lasted a week. The Gray-squirrels have come in since. There are now about 2 Grays to 3 Blacks, but both are pretty scarce.[24]

In Oct., 1865, there was, according to John H. Chatham, of McElhattan, Clinton Co., Pa., a great southward emigration of Black-squirrels in the country from Queen's Run to Larry's Creek—a distance of about 20 miles. The movement lasted 15 days. He estimated that, in this region, the slaughter amounted to 7,500. "Nearly all were Blacks; less than 5 per cent. were Grays. Many of them were so full of warbles that they were thrown away by the hunters. Less than 40 per cent. of those taken were entirely free of the pests, and I often thought that probably this was the cause of their leaving their natural haunts, rather than scarcity of food. About 1885, George McGuire, of McElhattan, killed 53 squirrels in a little 20-acre wood."[25]

According to the Bay City *Tribune* (Mich.), Feb. 17, 1907, there was a great Squirrel migration there in 1866.

E. H. Eaton, of Canandaigua, N. Y., writes me (1906): "In the late 70's, I witnessed a decided migration of Black- and Gray-squirrels in western New York. I was too young to realize the importance of the migration, but I now believe they came from the woods of northwestern Pennsylvania. Since then, I have seen only small migrations."

---

[21] Quads. Ill., p. 64.

[22] N. Y. State Entom. Rept., Sup., 1858.

[23] Quads. Ill., p. 65.

[24] Altoona Times-Tribune, Mar. 24, 1920.

[25] Ms. sent by H. A. McGraw, of Altoona, Pa.

MOVEMENTS SINCE 1870

Probably 1866 was the last of the great treks, though many lesser movements have been noted since.

Late in Oct., 1883, according to John C. French, of Roulette, Potter Co., Pa., there was a great southward Squirrel migration in the country about Kinzua, Pa., from New York State across the Allegheny River. Two men killed 40 that afternoon; not less than 500 crossed the river in front of Cornplanter reservation, within one mile. They were noted in similar numbers crossing the Allegheny River for 70 miles. This, he believes, indicates not less than 50,000 crossing in one day, or 150,000 in the 3 days that the movement continued.[26]

In the autumns of 1885–86–87, similar movements on a smaller scale were noted near Larrabee, McKean Co., Pa.[27]

George L. Fordyce, of Youngstown, Ohio, tells me that in 1886, he saw a Gray-squirrel migration along the chestnut ridge in Ashtabula County. The Squirrels were so abundant that there were 20 or 30 in sight nearly all the time. He and a companion shot 40 that day, then stopped. The migration took place in the early fall; it was said to be about 5 miles wide, and it continued for a couple of weeks. All travelled eastward, and all were Gray-squirrels. On these great treks, they commonly built temporary nests for one-night use.

Dr. Hartley Jackson writes: "In a previous paper,[28] I have noted a migration of northern Gray-squirrels (*Sciurus carolinensis leucotis*) across the Mississippi River from Wisconsin into Minnesota, during the autumn of 1905. The migration may have been caused by a shortage of nuts on the Wisconsin side of the river."[29]

And again: "On a field trip for the United States Biological Survey during the past summer (1920), I had occasion to visit Pepin, Wis. While there, Mr. [James P.] Broatch, a reputable citizen of that village, told me about a migration of Gray-squirrels which occurred early in the fall of either 1914 or 1915. The Squirrels came from the hills 2 or more miles back of Pepin, followed a point out into the foot of Lake Pepin, and there swam a distance of about one-fourth mile across the Mississippi River to the Minnesota shore. Mr. Broatch would give no estimate of the number of Squirrels, but said 'there was a continuous movement, and possibly an average of two entering and two emerging from the water every few minutes for about a day.' Mr. Broatch stated that there was no food shortage on the Wisconsin side of the river, there being an abundant crop of acorns, nuts, and corn."[30]

---

[26] Altoona Times-Tribune, March 18, 1920.

[27] As above.

[28] Bull. Wis. Nat. Hist. Soc., Vol. VIII, p. 87, 1910.

[29] Journ. Mamm., May, 1921, p. 113.

F. M. Fryxell, of Rock Island, Ill., writes:[31] "The following press item from Prairie du Chien, for Oct. 16, 1925, reports an interesting and unusual migration of Squirrels:

"'An acute shortage in the Wisconsin nut crop is causing thousands of Squirrels [*Sciurus carolinensis leucotis*] to seek the more bountiful cornfields of Iowa, according to hunters and fishermen who come to this city daily with stories of witnessing hundreds of the bushy-tailed animals gamely swimming across the Mississippi River. Entire armies of the animals congregate on the Wisconsin side, and wait for calm weather before attempting the long swim. Rough weather has proved fatal to many, whose bodies have been washed up on both shores, the hunters report.'

"The writer has not had opportunity to verify these interesting reports."

Causes of the Migrations

A truly migratory animal is one that makes a periodic change of range —has a definite going, and a definite return. Thus, the migration of birds, Bats, and Caribou are definite seasonal changes, followed always by a return movement. But the migrations of the Gray-squirrel will be found in a different class.

A careful review of the evidence makes it very clear that these were not annual, or periodic, or balanced by a return movement of any kind. They were simply wholesale outpourings of a huge population from one region to another; and, therefore, not true migrations, but rather emigrations.

Judging from numerous parallel cases, such movements could arise from only one of five causes— flood, fire, famine, pests, or overpopulation.

There is no evidence for the first or second. As to famine, Kennicott, who has the most complete and detailed observations of all, makes a point of it that they are not driven forth by want of food, for the animals are fat at the time, and the regions they leave still abound with provender. French's observations confirm this. Furthermore, the season when they go forth is *always early autumn*, the time of the greatest food abundance. The migrations that Merriam reports in the Adirondacks,[32] and Jackson in Wisconsin[33] were obviously due to food shortage. But these were very small and local affairs.

---

[30] Journ. Mamm., May, 1921, pp. 113–14.

[31] As above, Feb., 1926, p. 60.

[32] Mamm. Adir., p. 226.

[33] Wis. Mamm., p. 87.

It is possible that the vast multiplication of nesting places may have resulted in an unsupportable increase of parasites in the shelters, so that the nests had become untenable. But of this there are only two shreds of evidence at hand. One, the known fact that overcrowded squirrel nests breed abundant parasites; second, the Squirrels are scarce after the army has gone, for the urge of the insects is on all, though that of hunger be not. Thus, the evidence is far from conclusive.

We have, then, the last cause to consider—overpopulation. The army has always come from a land of plenty, a place of ideal Squirrel conditions, at a time when they seemed at their best; and further, the time of migration is always just as the broods of the year are full-grown. No one has ever recorded a Squirrel migration from a land where they were few or moderate in numbers; always from a place where they overabounded. No one has witnessed one of these treks since the Squirrels became comparatively scarce.

The explanation is paralleled by the known causes that send the Scandinavian Lemming and the African Springbok millions out of their country, and on till they meet their end. It is, moreover, exactly in line with the *swarming of bees*—the sallying forth of the new brood to seek a new home; for there is not room for them in their birthplace. In a word, then, the Graysquirrel swarms as the bee swarms; this explains their marching armies. But the dwindling of their numbers has put an end to their migrations.

The Lemming Parallel

Through the kindness of Dr. C. C. Adams, of Albany, N. Y., I have before me R. Collett's paper on the migrations of the Norwegian Lemming,[34] in which he gives a very full history of these amazing movements, founded on more or less detailed observations for more than 150 years. The following conclusions may be drawn:

1st. There is no regularity in these emigrations.

2nd. They are caused primarily by a sudden, enormous increase of the population in their home land.

3d. The hordes are crowded out by overdensity of population—not by hunger—and consist chiefly of the young of the year.

4th. Their home is the birch and willow region up near or above timberline, so that the formation of the country forces them to descend in going out.

---

[34] *Myodes lemmus:* Its Habits and Migrations in Norway, Christiania, 1895.

5th. In the new lower levels, they cannot live; none of the host survive, none ever go back.

6th. The favourable circumstances which caused this great multiplication extend to many other species of mammals, as well as to birds.

Every principle in this seems equally applicable to the Gray-squirrel.

In seeking for the causes which increase the fecundity of our species during the years of multiplication, I have considered food supply, weather, sunspots, etc., but have found no satisfactory explanation. Probably there is a complexity of causes. Above all, the impulse to move out is psychological. According to many observers, it looked like a kind of craze.

NUMBERS ANCIENT

How are we to form any idea of their numbers in primitive times, when the whole land was one big harvest field of nuts for their chief benefit?

The early naturalists seemed satisfied to describe the Squirrel hordes as "astounding," "immense," "myriads," "incredible," "unbelievable," etc.; and we rejoice that Kennicott and others of more exact mind, were born in time to make a fairly satisfactory record. Kalm relates[35] that in the year 1749 the State of Pennsylvania paid bounties for the killing of 640,000 Squirrels. In Capt. Mayne Reid's reminiscences, "The Hunter's Feast," published 1854, p. 167, is an account of an all-week Kentucky Squirrel hunt in which the sides, with 6 guns on each, killed respectively 5,000 and 4,780 Squirrels.

Robert Monro writes[36] in 1804 of Squirrel hunts in western New York, in which "upwards of 2,000 of them have sometimes been killed in a day."[37]

Howe's "Historical Collections of Ohio," 1874, p. 176, gives further interesting details. According to the Columbus *Gazette* of Aug. 29, 1822, a two- or three-day Squirrel hunt was organized to protect the grainfields of Franklin Co., Ohio. A total of 19,660 Squirrels were killed, besides which many hunters did not turn in their tale.

On Christmas Eve, 1807, the new-born State of Ohio declared war on the menacing Gray-squirrel hordes, by passing an act providing that county taxes in the State might be paid in Squirrel scalps, "in proportion to their county levies, provided it does not exceed one hundred, or less than ten." Each scalp in this levy was valued at 3cts., any over the needed amount

---

[35] Travels, 1770, p. 320.

[36] Description of the Genesee Country.

[37] Merriam, Mamm. Adir., p. 229.

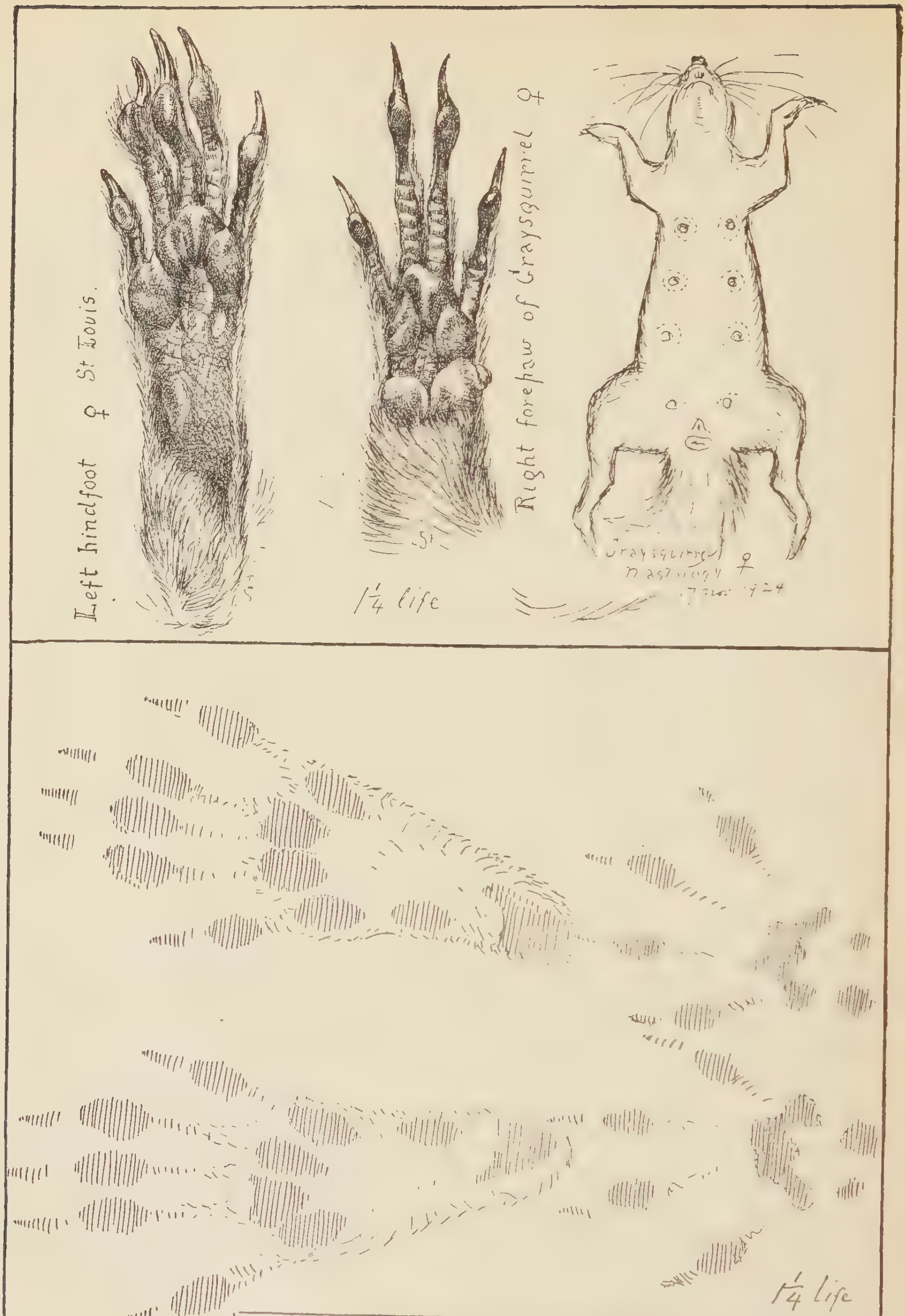

Left hindfoot ♀ St Louis.
Right forepaw of Graysquirrel ♀
1/4 life
Graysquirrel Washington ♀ 7 Nov 1924
1/4 life

Plate II. Graysquirrel details.

counted for 2cts. Just how it worked out is not clear; apparently not well, for the act was repealed Jan. 24, 1809, after 13 months' trial.

Audubon speaks of seeing the veteran Daniel Boone, then 80 years of age, "barking off Squirrels" on the Kentucky River about 1815. "We moved not a step from the place, for the Squirrels were so numerous that it was unnecessary to go after them . . . procured as many Squirrels as we wished."[38]

Nessmuk (George W. Sears) in *Woodcraft*, p. 120, relates that on a moccasin trip which he took in 1842, from Saginaw Bay, Mich., to Muskegan, "it was a Squirrel year. . . . I do not think there was an hour of daylight on the trip when Squirrels were not too numerous to be counted."

William B. Mershon, of Saginaw, Mich., writes me: "When I was a boy [1860] the woods around Saginaw were full of Gray and Black Squirrels. One could sit down under a hickory tree or an oak in September, and shoot from that one tree 12 to 15 Squirrels. Fox-squirrels were always comparatively scarce."[39]

Paul Fountain, referring to the Gray-squirrels during pioneer days in Michigan, says: "I have heard of a party of a dozen guns shooting as many as 20,000 Squirrels in a week."[40]

Dr. P. R. Hoy knew of an Ohio hunter who killed 160 in one day in an off season. "In parts of Michigan, Illinois, southern Wisconsin, and Indiana, they are no less numerous."[41]

Dr. Bachman saw 130 miles of the Ohio "strewed" with them in 1819;[42] an old settler of Bay City, Mich., records[43] that in the migration of 1866—one of the last—he counted 1,400 Squirrels while driving two miles.

Finally, if we recall, as the third dimension, that Dr. Hoy found it took a month for the army to pass, we have some basis for calculation. Allowing that the Squirrels travelled 5 miles a day (and we give evidence later of nearly double that), we have an army 130 miles wide, 150 miles long, in which as many as 1,400 might be seen by the road within 2 miles. That road must have been through the woods; therefore, 20 yards on each side would be the limit of view. This would mean 30,000 to the square mile, or 450,000 Squirrels in the dimensions recorded. Such numbers seem incredible, and yet that is what the old naturalists said they were—"unbelievable," "incredible," etc.

---

[38] Aud. Journal, II, 1897, p. 460.

[39] Letter, Dec. 3, 1919.

[40] Great Northwest, 1904, p. 254.

[41] Quads. Ill., p. 63.

[42] Q. N. A., I, p. 272.

[43] Bay City Tribune, Feb. 17, 1907.

Even if we largely discount these figures, we must remember that there were many such armies, and that only a small section of the range was represented—not more than one fortieth of it.

A corroboration of these high rates is found in a round-up that took place in Central Park, New York, in 1901. The Gray-squirrels had become so numerous that it was decided to thin them out; 300 were shot in one week, without making much perceptible difference. There were at least twice as many left in the woods which cover nearly half of this 800-acre Park. That is, there were over 1,000 to the 300 acres of timber.

In my recollection of a Squirrel woods in Ontario, 1887, the numbers in Central Park are not to be compared to those in the Northern range. They were at least three times as numerous in the latter, and yet we know that there were about 3 to the acre in the Park.

The range of the Gray-squirrel is about 1,000,000 square miles. Allowing that, in half of this, they were scarce, or wanting, and that in the teeming parts, they were no more numerous than in Central Park, we have an estimate of 1,000,000,000 as the lowest reasonable guess at the primitive number, that is, in the palmy days of 1800.

The Desolation

Wholesale slaughter as described, combined with the reckless destruction of the nut-bearing forests, could have but one result. The great treks ended in the '60's, the big hunts in the '70's. The Gray-Squirrel became scarce in the '80's, so far as the main range was concerned. In the '90's, men talked of the total extermination of the species. The darkest time of all was at and following 1895; this was the high peak of relative slaughter, and the low ebb of numbers.

During the period from 1895 to 1915, I personally visited every State in the Gray-squirrel range—not as a hunter, but as a passing traveller—and outside of the city parks and protected areas, never once saw a wild Gray-squirrel.

I have before me now a long article from *Forest & Stream*,[44] describing tne two-days' hunt of 5 men in the best Squirrel country of West Virginia. The product was 3 Squirrels.

Nevertheless, these circumstances do not prove that the Squirrels were wholly gone, but rather that, first, they were enormously reduced in numbers; second, that the remnant had become exceedingly shy and retiring. They were ready to hide at the first intimation of a gunner's approach.

---

[44] Oct. 9, 1909, p. 576.

THE NEW DAY

But the day of the bloody side hunt is gone—the method is reprobated even where possible. Good game laws have ended extirpatory slaughter—have, indeed, made strides in the way of restoration.

It is neither possible nor desirable to reëstablish the Gray-squirrel myriads in measure of a hundred years ago. But we should certainly restore, in some degree, the Gray-squirrel to its former position, as an abundant and recognized game animal.

There are, of course, five well-approved measures to achieve this:

1st. Protection by adequate laws, duly enforced. This would mean a long close season for a time; then a brief open season each year.

2d. Sanctuaries in which no shot is ever to be fired.

3d. Restocking the areas of extermination

4th. Nesting boxes in abundance, with winter feeding in bad weather.

5th. War on the Gray's enemies—the Red-squirrel, the Cooper-hawk, the stray Cat, the self-hunting Dog, and the pot-hunting poacher.

Such a programme, fairly carried out, would undoubtedly bring back the Gray-squirrel to any desired extent, and furnish us with a game animal that would supply more sport for young America than any other animal now in sight.[45]

Already we are getting good results, and, as samples, the following should be pondered:

Edward H. Forbush tells me that, in his early days, the Gray-squirrel was unknown in Plymouth Co., Mass. About 1895, a Gray was seen swimming across the Agawam River at Wareham, going from the Barnstable side towards Plymouth. A fisherman in his boat came along, the Gray-squirrel scrambled aboard, and was landed on the north shore. Since then, the species has multiplied greatly in Plymouth; although there is little or no big timber, and its nests are perforce in the crotches of second growth. He has, within 2 years, known as many as 14 in sight at one time.

While at Fitchburg, Mass., Jan. 12, 1920, I met C. L. Grubb, the well-known sportsman. He said that, in 1917, introduced Gray-squirrels were so plentiful in the country within 50 miles around Fitchburg, that one could see 20 to 25 every day in a short tramp. The hard winter of 1917–18 seemed to wipe them out; all disappeared. It was supposed that they had migrated, though no one knew where. The next year there were none at all. But now they are coming back. This autumn (1919), one could reckon on seeing an average of 2 in an ordinary morning tramp.

---

[45] It is worth remembering also that the Russian Gray-squirrel would almost surely do as well here as our own species, and has the additional merit of producing a valuable fur.

In the City of Washington, Feb. 14, 1920, I saw hanging outside of a fur-dealer's shop some 50 recent skins of Gray-squirrels. The dealer assured me that all had been killed near the city.

More satisfactory evidence of their continued existence is found in the State Game Reports, of which the following are samples: In Pennsylvania, according to the official records, 63,120 Squirrels were killed during the season of 1921.[46] In New York State, the official reports for 1918, 1919, 1920, and 1921, show that the numbers of Black- and Gray-squirrels legally taken for those years were respectively, 126,041; 147,122; 175,045; 143,906.[47]

Since the above drain appears to be not more than the Squirrel tribes can stand, it implies that, in New York State, there are still 750,000 Squirrels and in Pennsylvania, 250,000. These two together form about one fifteenth of the Gray-squirrel range, so that it may imply that there are still 15,000,000 Gray-squirrels on the range—quite enough for seed if we take reasonable care of them.

Their Last Stronghold

Amid stories of slaughter and desolation, in the main range, I was rejoiced to learn that in one corner of our forest, there are Squirrels yet to be seen in something like primitive conditions.

The pleasant variant comes from Doniphan, Mo., where John B. Thompson of Chicago, editor of the *Sporting Goods Journal*, found the Gray-squirrels so plentiful in 1901, that pot-hunters secured four or five dozen in a morning's hunt; and made wages, selling them to the Railroad Construction boss for 5 cts. apiece. In 1905, again they began to return in countless numbers, and menace the new corn crops in the lowlands; and did so as late as 1907 at least.[48]

On Dec. 8, 1919, this same sportsman wrote me a letter to the following effect: Fox-squirrels and Gray-squirrels are still abundant in Missouri, the Fox predominating on the hills and the Gray in the swamps. In the swamps of Cane Creek and Black Rivers, Mo., Squirrels were very plentiful in the fall of 1901. He roughly estimates that he saw 100,000 of them in one day that year. On one pecan tree alone he counted 354. This seems to have been much like the old-fashioned Squirrel years.

They are less numerous now, but still plentiful; for, in the November of 1914, he knew of one hunter who bagged 148 in one day near Moorhouse in Little River Swamps, Mo. Their numbers were incredible until the old mills cut down the big hickory forest for sucker rods.

---

[46] John M. Phillips, Penn. Game Refuge System, p. 13.

[47] 13th Ann. Rept. Cons. Comm., 1924, p. 91.

[48] Forest & Stream, Sept. 7, 1907, p. 376.

The timber camps and sawmills kept hunters after them all the time to feed the men; and they made two hunts a day, corresponding with the Squirrel's two active periods, early morning and late afternoon.

In the December of 1919, he received word that the Squirrels were moving from the swamplands back to the hardwood ridges. He went there in time to see the last of the migration. On Dec. 31, 1919, 1,104 Squirrels passed his stand, all going westerly; next day, an even 500; next day, 278; next day, none—the movement was over.

In the first part of Feb., 1920, I went to Blytheville, Ark., on the south border of Missouri. It was said to be a good Squirrel country. But the woods were flooded everywhere. I tramped for hours with a native guide yet did not see one Squirrel of any kind. There can be no question that Gray-squirrels still abound in parts of Missouri and Arkansas, though they were much more plentiful a few years ago, according to Sam Warren and other hunters of Blytheville.

Warren tells me that there was a great migration of Gray-squirrels in the south part of Pemiscot Co., Mo., in the early part of Sept., 1914. They were first heard of at Tyler. After two days, during which they covered 16 or 17 miles, they were reported in his neighbourhood in Pemiscot. He went after them, and found them as said—a huge, solid army of Gray-squirrels travelling westward. They were so thick that, though in the woods, there were always 400 or 500 in sight, and at least one always to the square yard.

They were practically all on the ground, and reminded him exactly of a flock of blackbirds feeding, the hinder ones continually dashing ahead, when the front ones stopped to eat. All were Gray-squirrels, both sexes and all ages represented.

The army was about three fourths of a mile wide, a quarter of a mile deep, and was remarkedly compact. There must have been over 500,000 Squirrels in it. They were travelling about a mile or a mile and a half an hour, although later observation seemed to show that they went only 8 or 9 miles a day.

Their total march, so far as known, was only 25 miles, unless they came from Tennessee across the Mississippi. But this is unlikely, as no one there ever heard of it. They went on to Dunklin Co., Mo., and it is believed scattered on Slaydon Ridge.

These Squirrels were in good condition, fat and well; the country they left and the woods they passed through, abounded in food, both nuts and mast; there was no flood on the bottomlands. No one could account for their hurrying on so, unless it was a kind of craze.

About 1910, Warren tells me, it was usual to kill 75 to 125 Gray-squirrels a day. Most men stopped at that, because it was all they could carry; the Squirrels averaged a pound each. It would have been easy to greatly increase the number, as he has often seen 40 to 50 in one tree, and got 10 to 12 of them before the rest escaped. The most he ever killed in one day was 135 in 1910; but his friend, P. K. Jackson, killed 147 at that same time.

They are much scarcer now (1919); 15 to 20 a day is considered a fair bag.

FANITASHO'S FARE

The food of the Gray-squirrel is chiefly nuts in the nut season, berries in the berry season, grain in the grain season, and buds of maple and elm when all else fails. But there is evidence that many—nearly all available—kinds of seeds, acorns, leaves, roots, bulbs, and tubers, insects and fungus, must be added to this list as staples.

Occasional indulgence in birds' eggs and fledglings is only too well known. This, however, is not so strong a count against the Bannertail as it may seem at first sight; for there is evidence that the bird-eating Gray is a freak, a rare and morbid accident. When a whole parkful of them take to eating birds' eggs, it is usually the result of an unbalanced diet, or improper food, such as peanuts. If the habit were general, no bird could ever have raised any young in the hardwood forests of the Mississippi Valley; whereas we know that the wood-birds abounded in Squirrel days, even more than now.

Bachman says that "this Squirrel is at particular seasons of the year, known to search for the larvæ of different insects which it greedily devours."[49]

An interesting article by W. T. Davis, of New Brighton, S. I., ascribes to the Squirrels a fondness for the *Balaninus* larvæ, which bore into acorns, etc.; also *Clisiocamoa* cocoons from the wild cherry.[50]

Kennicott records that they are very fond of the black haw (*Viburnum lentago*).[51]

Dr. E. A. Mearns writes: "I have seen Gray-squirrels eating the large fungi of which so many animals are fond [Russula]. In winter, they tear open the pine cones and devour the seeds. On Jan. 28, 1883, I watched a pair gathering the 'beans' from the pods of a thorny locust tree."[52]

---

[49] Q. N. A., I, p. 269.

[50] Forest & Stream, Feb. 9, 1907, p. 214.

[51] Quads. Ill., p. 65.

[52] Vert. Faun. Hud. High., 1898, p. 341.

George H. Corsan writes me that his captives are fond of lettuce.[53]

Now, as I write this, there are 3 Grays under my window hard at work, as for a week back, gathering and burying the products of a huge red oak.

In the winter, I have them trained to come to a food tray. Both Grays and Reds come, and do not seem violently hostile. The Grays eat their food on the tray, the Reds invariably carry it away to some high, safe place before making their meal.

In an extended article, Fred E. Brooks, of French Creek, W. Va., records a new food habit for the Gray-squirrel. He found that they had regular bark-eating stations on the under sides of all leaning chestnut trees, usually 1 to 10 feet from the ground. These extended for 6 to 8 feet up the trunk, and were used for years. In a few cases, chestnut oak and white oak also were gnawed.[54]

Amid all this diversity, the species is, above all, a nut-eater. This and all its near kinsmen are voraciously fond of hickory nuts, hazelnuts, chestnuts, black walnuts, pine nuts, and acorns.

There is one staple food, that is probably the chief on the list supplied by children, and that should be omitted altogether. That is the homely, handy, alluring, toothsome peanut or goober.

Thomas M. Jones gives[55] a lengthy warning which is confirmed by George H. Corsan. Writing of the Gray-squirrels in Capitol Park, Harrisburg, Pa., he says that when they first came "they were fed peanuts because the people did not know any better, and it was not long until their fur got thin and ragged, and they became mangy and sickly." Wiser friends substituted pecans, filberts, walnuts, and other real nuts, and soon the Squirrels became fat and "sassy," their fur "thick and glossy, and their tails bushy and luxuriant."

His Favourite Food

While there is little on the woodland bill of fare that the Gray-squirrel will not eat, all observers agree that his favourite food is the hickory nut. This is the food that created the Gray-squirrel species. Where the hickories are, we find the Gray-squirrel; their ranges practically coincide, and the great central region that was the teeming homeland whence came the Squirrel armies of other days, was also the region where the hickories most abounded, and grew in greatest perfection. And where the hickories did not grow, the Gray-squirrel was at best a mere straggler, a curiosity to the hunters who ran across him.

---

[53] Letter, Nov. 3, 1919.

[54] Journ. Mamm., Nov., 1923, pp. 257-58.

[55] Forest & Stream, July 4, 1908, p. 10.

His appetite for hickory nuts amounts almost to a passion. He will pass by all other foods, and brave innumerable dangers for a feast of his favourites. So eager is he for the annual bounty of his mother tree, that he cannot await the decent time of ripening, but cuts them while they are green. He is like an overeager, overgreedy small boy who is too impatient to wait for the thorough baking of his cake, so nibbles and nibbles at the unsatisfactory, unwholesome dough.

Possibly the Gray-squirrel is jealous of his treasure, afraid someone will get it before he does, if he delay. He cuts off the nut branches while they are yet so green as to furnish almost nothing in the way of food—chiselling off the husks with his swiftly working jaws, sending down to the leafy ground below rattling showers of chips from the brown-stained, juicy outer coat.

Bachman supplies picturesque details of the feasting methods of the species. "With its lower incisors," he says, "it makes a small linear opening in the thinnest part of the shell immediately over the kernel. When this part has been extracted, it proceeds to another, till in an incredibly short space of time, the nut is cut longitudinally on its four sides, and the whole kernel picked out, leaving the dividing partitions of the hard shell untouched.

"At the season of the year when it feeds on unripe nuts, its paws and legs are tinged by the juices of the shells, which stain them an ochrey-red colour, that wears off, however, towards spring."[56]

Nevertheless, Bailey is of the opinion that "the more abundant, more fruitful, and more widely distributed oak trees afford more good, wholesome Squirrel food than all other trees combined." (*Personal note.*)

STORAGE

Everyone who has fed the Gray-squirrels in a city park, has noted the nut-burying instinct. After one or two nuts have been eaten, and hunger satisfied, the Squirrel accepts as many more as are offered; but takes them one by one to hide, no doubt for future use. His procedure is always the same. He receives the nut in his teeth, then takes it in both paws, puts it back in his mouth, turns it round, licks it with his tongue, then goes off a few bounds, and, with forepaws, digs a hole in some open place, making it about 3 inches deep. Holding the nut in his teeth, he rams it down point first, into the hole; with his snout, he roots the earth back into place, tamps it down a little with his paws and his snout, replaces the leaves, combs up the grass with both paws, and goes off. If another Squirrel come near at once, the owner of the cache drives him away.

---

[56] Q. N. A., I, p. 270.

Commenting on this account, Bailey adds: "If the nut is cracked ever so little, the Squirrel will examine it with great care, and usually eat instead of burying it."

Thomas M. Jones, of Harrisburg, Pa., sends the following case in point: "In Capitol Park, recently," he says, "Judge Hargest handed a nut to a Squirrel which ran off a short distance and buried it. Out of curiosity, the Judge sought to ascertain how deep the nut was buried; and as he stooped down to scratch away the earth, the Squirrel made a sharp dash at him, and knocked his hand away from the hole."[57]

If, however, the stranger does not come near for 10 or 15 minutes, the cache-owner seems to have forgotten the buried treasure; or maybe his strong sense of proprietorship has weakened a little, and he pays no attention.

A piquant incident is given by a Florida correspondent of *Forest & Stream*, Dec. 3, 1898, p. 448: "The Gray-squirrels," he says, "at Clearwater were amusing as they chased and chattered in the limbs of a hickory a few feet from our porch, at times rowing with the bluejays, with whom they seemed to be at constant war, and at other times marching over the grass—a sedate procession, in which the leading Squirrel buried a nut that was dug up in turn by each of his followers; the line reforming itself and reburying the nut till none of us could calculate either how many Squirrels would be disappointed, or how many times, when the season came for harvesting cached food."

I have seen a park Squirrel bury 10 out of 13 peanuts within an hour, each in a separate hole. I have seen a wild Squirrel bury 5 acorns in 3½ minutes, Oct. 15, 1909. They keep on doing this every fine morning during the three months of the nut season, so that each Gray-squirrel probably buries several thousand, maybe ten thousand, nuts in a season.

Any brotherhood of Gray-squirrels that one may watch in late October, when the hickory nuts are rattling down on the dry leaves, will be found hard at work digging little holes to bury nuts, usually one in each, but sometimes, under rare stress of hurry, two or even more nuts in a single grave.

Walter L. Hahn says that on the University Farm, Mitchell, Ind., "in the autumn of 1906, the crop of acorns was very large. I estimated that each of the large white oaks produced from 2,000 to 8,000 acorns during that season; 80 acres are heavily wooded with white oaks, and nearly 100 acres more have a considerable growth of these trees. Before Nov. 1, the immense crop of acorns had been so completely garnered by the Squirrels that none were in sight on top of the leaves, and only an occasional one could be found by the most careful search."[58]

---

[57] Forest & Stream, July 4, 1908, p. 10.

Twenty large trees to the acre would not be very heavily wooded, so that 100,000 acorns per acre, or 20,000,000 on the whole farm might have been the crop. This means that, to stow away that harvest, the Squirrels had, inside of two months, operated 20,000,000 times, dug 20,000,000 holes, and buried 20,000,000 separate nuts. Even if 100 Squirrels were concerned, it evidences a maximum of tireless, day-long industry.

The Forest Planter

Why does the Gray-squirrel do this, and do it so assiduously? Undoubtedly, the underlying idea is to lay up a store of the present abundance, for use in time of scarcity. But how can he find the place of each of the many caches, especially when months elapse, and snow is on the ground, when hard frost is in the air, and the earth is like stone? It seems absolutely certain that he does not find more than a very small proportion of the buried treasure.

What happens to those that he does not find? *They grow.* Here, I think, we have the true answer. The Gray-squirrel, prompted by a blind instinct, was planting nut trees for his posterity to enjoy.

Acorns fall to the ground, and are slightly covered by the leaves. If undiscovered by birds or mice or deer or Pigs, they burst their shell, send down a tap root, and up a sap shoot. They need no planting; they can care for themselves from the start. But it is otherwise with the hickories, the butternut, and the walnut. They must be planted, or they dry up before their shell is burst. Hence the compact of the hickory tree with the Gray-squirrel: "You may eat one half of my nuts, if you agree to plant the other half."

We are nearly safe in assuming that every hickory tree in America to-day has been planted by a Squirrel—probably a Gray. There are, of course, a few planted by bluejays and Chipmunks, and some buried by accident; yet, as a broad proposition, the Gray-squirrel was the industrious husbandman who planted the hickory forest of America.

But he was quite unconscious of it, when he did it. He meant to come back for that nut; he let posterity indeed take care of itself. In many cases he came back and found the buried treasure. How did he find it? This has long been a moot question.

---

[58] Mamm. Ind., 1908, Proc. U. S. Nat. Mus., p. 569.

There is no doubt in my mind, after much observation and much testimony gathered, that the nut-hider is guided to the locality by his memory, and to the exact spot by his sense of smell.

Dr. Robert T. Morris found that, when acorns were buried one inch deep, the Gray-squirrels went unerringly to them; those buried 2½ inches deep were found, but not with certainty; nevertheless, a Squirrel went direct to 3 rather "high" acorns accidentally buried under "nearly 6 inches" of very wet sand.[59]

Merriam says: "Many persons who have observed this habit in summer regard it as an idle pastime, and question if the Squirrel ever finds the nuts again, knowing that he could never remember the exact positions of so many. But those who have kept tame Squirrels must have been struck with the remarkable certainty and quickness with which they detect the whereabouts of nuts that are hidden from sight. A Squirrel will often scratch and gnaw at a tight box or drawer that he has never seen before, if a few nuts happen to be in the bottom of it. His sense of smell is very acute, enabling him to detect the presence of a nut at some little distance; hence, though he does not, of course, remember the exact spot where each one is buried under the leaves, he can, by moving carefully over the ground, discover a great many of them."[60]

I have repeatedly seen by the tracks that a Gray-squirrel had galloped over two feet of snow, then without an error or a trial shaft, dug straight down to the nut or acorn buried also under the leaves.

I have read the serious statement that the Squirrel nips off the tip of each hickory nut to prevent it growing. This is a mistake. First, he does not nip off the point; second, it would not prevent it growing if he did. Chipmunks have been known to cut off the sharp points of nuts that pricked their cheek pouches, but I never knew a Gray-squirrel to waste time trimming the nut before burying it. The story must be classed with the myths that tell of the Gray-squirrel going for a sail on a bark chunk, with his tail spread for a canvas, and with that famous one by the corner grocery Munchausen, that credits the Squirrel with castrating his male prisoners of war.

Many of the Squirrel family lay up a great store of food in one place for winter, or early spring use; but all the evidence at hand shows that the only store of the Gray-squirrel is in the myriad little one-nut caches scattered over the forest floor of his home range, as already described.

Since digging a hole is essential to this kind of storage, one might suppose the instinct to go dormant when the ground is hard frozen. This seems not to be the case. For, on Jan. 23, 1921, in Washington Zoo, I saw a Gray-squirrel burying a nut, chiefly with leaves. Dr. Lillian D. Powers tells me that her pet Gray-squirrels store nuts at all seasons, winter as well as fall. And Merriam expressly says: "In winter, this habit of storage is almost equally marked, and the first thing a Squirrel thinks of after his hunger is satisfied, is to secrete a portion of the food remaining at his disposal. In accomplishing this, he tunnels into the snow in various directions, hiding some of the surplus provision in each excavation."[61]

---

[59] Guide to Nature, Nov., 1915, p. 195.

[60] Mamm. Adir., pp. 224–25.

Drink

Some of the Squirrels are happy dwellers in the land of "Little Rain"; some even rejoice in the arid deserts. But the Gray-squirrel needs water in abundance, fresh and flowing, once or twice a day.

Bailey says: "They are thirsty animals, requiring water at least once a day, and drinking several times a day if a supply is available. Often they are obliged to leave a locality where water is not to be had."[62]

An Evil Appetite

Although the Red-squirrel is, among rodents, the chief malefactor in the destruction of songbirds and their nests, there can be no doubt that occasionally among the Gray-squirrels, as well as the Fox-squirrels, there are found depraved individuals whose crimes must be reckoned with.

Bernard Bailey, of Elk River, Minn., lists the following nests robbed by Gray-squirrels in 1914: Baltimore oriole, chipping sparrow, robin, bluebird. Also adds, June 10, 1915: "I saw a Gray-squirrel enter a hollow limb 25 feet from the ground, and come out with a half-grown bluebird in its mouth. The bird was still alive."[63]

When such cases are observed, it is well to assume that we have found an individual of morbid tastes; and as soon as possible, inflict on him the extreme penalty of the law. But we should not, for the sake of the black sheep, give sweeping condemnation to the entire woolly herd.

Sociability and Games

Outside of the great migrations, the Gray-squirrel is, in only a slight degree, gregarious. But it is a truly sociable animal, though not of the highest development. The individuals occasionally help each other in combatting an enemy, such as a hawk or a snake; but usually they assist only by passing on an alarm of danger. Several times, I have entered a Squirrel woods where all was noise and bustle as they feasted and frolicked. Flashes of Squirrel were to be seen in all directions; and the nut hulls, showering down, sounded like rain. But the moment my hostile presence was known, there were two changes. First, the loud *quack quack* of tribal warning; second, a complete stillness. Every Squirrel had acted on the hint, and silently hidden away, not necessarily in hollow trees or very dense thickets—though both are used—but chiefly by lying flat against the trunk or limbs of the tree they chanced to be on.

---

[61] Mamm. Adir., p. 224.

[62] Mamm. D. C., p. 109.

[63] Journ. Mamm., May, 1923, p. 129.

One may prowl around and search for any of the scores of Squirrels that one knows are all about—but without success. They are not easy to find; they have learned the lesson; they lie absolutely still. Or, if they move, it is at most to sidle round the tree that you are circling, and so keep always its solid trunk between themselves and your murderous lead.

In the winter time, they have the pleasant social custom of sleeping half-a-dozen in a den. Probably this group is the mother and her last brood. But the children are full-grown now, and on their own; so that the group is a social one. At least, they are profiting by the warmth of one another's bodies as they sleep.

An interesting play game between Squirrels and Cottontail is reported to me by Miss E. A. Robinson, of Eaton's Neck, Northport, N. Y. A brood of young Gray-squirrels was raised in a tree at the end of their garden; and every evening between July 10th and 16th of 1923, the 4 young Gray-squirrels were met after sundown by a young Cottontail Rabbit that romped and played tag with them.

Hibernant

As already noted, the Gray-squirrels have no grand storehouse of food for winter. More or less they must forage, and at least go forth to profit by the caches of last autumn's crop. This they do in spite of snow and some very cold weather. But there can be little doubt of this: the Gray-squirrel may hibernate whenever the mercury falls so low as to be a menace to his life. That is, when it is far below zero weather, the Gray-squirrels prefer to stay at home, curled up in a bundle in some hollow tree or bird box, keeping each other from freezing to death, and not really needing food; for all the wants and wastes of their bodies are nearly, if not quite, suspended when they go into this helpful lethargy.

I saw an illustration of this as far south as Washington, D. C. On the 14th of February, 1920, during a cold spell of dull, bleak weather, after much snow had fallen, I went into the National Zoo to get some pictures of a Gray-squirrel. I tramped over the park for two hours—2:30 to 4:30 in the afternoon—and saw no sign of a Squirrel, though Director N. Hollister assured me that there must be nearly 500 loose in the park.

To this, Bailey adds: "During blizzards and severe winter storms in Minnesota, they sometimes remain in the nests several days at a time, but will then come out when it clears, even if 30° below zero."

HIS TAIL

Of all our Eastern quadrupeds, the Gray-squirrel has the most wonderful development of tail. It is as large as himself, and much more conspicuous. He looks like a huge tail drifting along, pushing a small animal ahead of it. Most of his names are in some sort suggested by his vast and beautiful tail. Thus, "Squirrel" means "shade-tail"; "Bannertail" and "Silvertail" explain themselves.

So large a feature must exercise a large influence on the creature's life, as indeed it does. Most tree Squirrels have developed the tail as a parachute, a fall-breaker, an easy-lander; and it finds its perfect development in the group of which the Gray-squirrel is the best known member. As though conscious that its usefulness depends on its perfect form, the owner is continually combing it, and fluffing it, jerking the end with a tireless industry that recalls the Beaver at his dam. Pine-gum or burrs in his body coat he may tolerate for a time; but any foreign substance in the long ailerons of his tail, he instantly sets about removing.

When I was a small boy, I once chased a stray Cat to the top of our three-story house. From an open attic window, it leaped to the boardwalk some 28 feet below. I rushed to look, and saw the Cat in the air, splayed out flat like a Bat, with its tail spread, pointed upwards and rapidly whirling round and round. The Cat landed on the sidewalk with a flop, and bounded away unharmed. The incident deeply impressed me; then later, as I remembered how hard that tail had worked to keep the Cat right-end up, and finally to land her safely, it gave me a new idea of the tail's uses. It was one of the things that first made me think of the Squirrel's parachute, and the vital service that it renders him.

Especially is this true during the ice storms of winter; for then the Grays make many a slip, and fall from tree-top to ground. One of my early memories is of seeing a Black-squirrel, treed on a lonely elm, leap 50 feet to the ground, and escape to the woods.

Merriam speaks of one leaping safely to the ground from a limb "fully

80 feet high." He adds: "In winter, when the trees and branches are covered with ice, I have several times seen these Squirrels fall nearly a hundred feet, landing in the snow; but never knew one to be injured by the accident."[64]

In Arkansas, the hunters say the Gray often leaps 100 feet to ground, and is never hurt.

If 100 feet, why not 200 or 300—or the greatest height of any tree in any forest? Apparently, the Squirrel has the problem solved: Granted only that his tail be in good fettle, the fear of falling need never enter into his mind; but I have seen a young Gray get a bad jolt with a 30-foot fall. A Squirrel that has a defective tail is not wise in taking big chances; but these are the weaklings that inexorable evolution weeds out. This was part of the process that blessed our Gray-squirrel with his matchless feathery plume, the father of the sausage balloon, the ancestor of the parachute. And this I think we may accept as proven: A Squirrel in perfect form cannot be killed by a fall.

Since this paragraph was written, I have spent the day at work on a high scaffold; and I must confess, in consequence, that the Squirrel has rather lost in my esteem as a fearless climber. For what merit is there in it if a misstep and a hundred-foot fall mean nothing but a good laugh; no more, indeed, than if I were crossing a brook by a plank, and slipped so that I landed in water up to my ankles.

A curious incident, remotely akin, is furnished by Dr. Randle C. Rosenberger, of Pennsylvania. He watched a large Gray-squirrel climb some 30 feet up an oak, then perch "on a small dead limb to observe. He no sooner alighted on the limb than it broke off. He never let go, but came down with the limb firmly grasped, and as soon as he hit the ground, he bounded off out of sight, none the worse for his fall," in spite of the extra weight.[65]

There is another service rendered by the tail. It is the Squirrel's national flag, his identification and token to others of his tribe. And, to give it further usefulness, to make sure it is seen and known, he is forever fluffing and flirting the end of it. This may be to keep it in order, but incidentally, it also serves as an identification signal oft repeated. It certainly catches the eye, and announces the owner a hundred yards away, when otherwise he would escape all notice. Of course, it may, by the same token, betray him to an enemy.

As will be seen in the Fox-squirrel Life, the tail also serves as a foil and shield in battle.

---

[64] Mamm. Adir., p. 222.

[65] Forest & Stream, Aug., 1922, p. 355.

A picturesque but probably unimportant office is as a sunshade when the Gray is sitting in the open.

The final, and least vital service of his tail is as a bed-tick and blanket when he curls up in cold weather, to sleep away the worst of the time in some hollow tree.

Powers—Speed and Jumping

The speed of the Gray-squirrel, if measured on a straight course, would show but a low rate. As a boy, I have often outrun one on the ground, or on the rail fence; but the Squirrel's marvellous quickness at dodging and turning more than makes up, so that it is a rare thing when a Dog or Cat actually captures a Gray-squirrel without the assistance of a gunner, or a boy who has the gift of hurling deadly missiles with precision.

On April 23, 1920, a Gray-squirrel ran for 100 feet just ahead of my car on the drive. The car was going 12 miles an hour, and the Squirrel going his fastest and barely keeping out of reach. This, I think, is the maximum speed of a Gray-squirrel for a spurt.

When foraging on the ground, or along a fence, he usually takes six or eight hops of about 12 inches each, then stops to jerk his tail, sit up, and look around. If, however, he is travelling, he increases his hop lengths to 24 inches; if speeding, rises to 36 inches; if going at his best pace, 5 feet is covered at each hop. This is, I think, about the limit. Six feet is the widest jump on a level from tree to tree that I ever knew a Gray-squirrel to make.

In my notes at Greenwich, Conn., I find the following: May 26, 1921. Saw a Gray-squirrel run up to the cross-tree of a telephone pole near Little Peequo Lake. He uttered a peculiar, defiant "*n'grrr, n'grrr, n'grrr,*" many times; then leaped across a 20-foot space to a tree, landing 10 feet lower. This was the widest leap I ever saw one make, but would be equal to not more than 6 feet on the level.

Track, Dung, and Sanitation

The track in the dust or snow shows sometimes the pairing of the fore feet like most tree-climbers, and sometimes the alternation of the tracks that is the rule among ground-walkers. (See Plate II.)

The dung is of the usual Squirrel character, in pellets. It differs from that of the Red-squirrel only in size, and is much like that of the Fox-squirrel. (See Plate LXXVIII.)

So far as noted, the species is low in the department of sanitation. Even in cages, it does not set apart a corner for the solid by-product of its food, although it does establish a urinal. Its nest, after the young have left, is

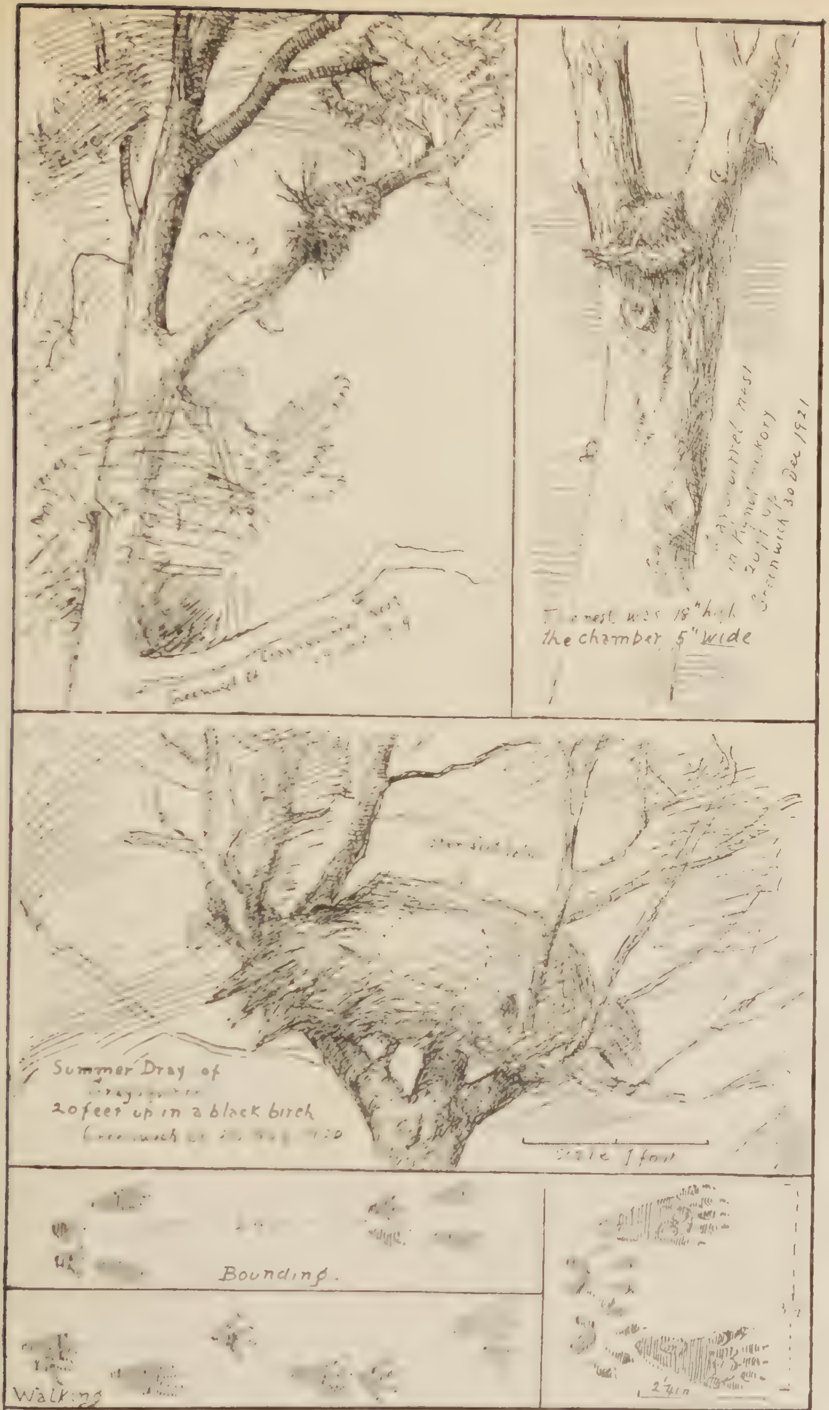


Plate III. Graysquirrel nests & tracks.

commonly stale and swarming with vermin; and usually the only remedy is a new nest, in a different tree.

It does, however, dress its fur, and wash its face with commendable regularity.

So far as known, it is remarkably free from disease.

INTERCOMMUNICATION

It is more than likely that the species has developed also a glandular mode of signalling; but of this, I have very little proof at present.

The signal use of the tail has already been mentioned.

The voice is the chief communicative mode of the Gray-squirrel. The *quack*, *quack*, *quack* of danger, the loud love song described later, the low purring of pleasure, and the short scolding *quaaa*, are the only sounds I have noticed in general use among them. As I write these lines, there are, outside my window in the woods, a number of Gray-squirrels calling, and on the lake a number of female mallards. Their calls are so nearly alike that I must listen attentively to distinguish them.

Dr. Lillian D. Powers, after keeping a study collection of Gray-squirrels for more than 30 years, writes me as follows:

"The best known sound the Gray-squirrel makes is, no doubt, the loud staccato '*quack*, *quack*, *quack*,' repeated rapidly many times, and often emphasized by the sound '*maeck*, *maeck*' being added to it. This call (unless it is the beginning of the 'song') indicates that the Squirrel has been startled. It expresses intense excitement, and irritation; and may, in its continuance, express anger or fear with a certain defiance. The call inevitably startles and alarms any other Squirrel in the neighbourhood, and thus serves as a warning in case of danger. The call breaks forth like a rattle of musketry, with a startling effect on all who hear it. This may be followed by a short, steady '*quaa*, *quaa*,' often with a rising inflection, uttered at intervals almost rhythmically; it expresses displeasure, annoyance, and even gloom.

"There is also a heavy buzzing sound made up of a quick succession of tiny grunts like '*n'gr*, *n'gr*, *n'gr*'—nasal, throaty, and ventriloquial all in one, which when soft and low, may be described as 'purring.' This may mean sexual approach, or in association with a human being—affection, petting, or pleasure. But, when loud and increasingly insistent, it may express resentment and jealousy; it now becomes a violent protest, an angry rebuke, a muttered threat, and is to be regarded as a danger signal.

"Another warning is the *chattering of the teeth*, which sounds like a smothered and low clicking of castanets, sometimes accompanied by a choking squawk. When a Squirrel is face to face with one whom he hates or is angry at, this teeth-chattering is so emphatic that its meaning, 'I'd like to chew you up,' is readily understood."

Song

The Gray-squirrel has a famous song that can never be mistaken for any other sound in the woods. At early sun-hour, he sends it ringing through breeze and trees, always from some high perch, sometimes swinging in the wind, not in the least caring about his own position—head up, tail up, hung, or hunched—he vents his gladness in the loud *Quack-quack-quack Quaaaaaaa-aaaaaaa, Quack-quack-quack-quack-quack-quaaaaaaaa aaaaa.* This is sometimes called his barking; but, measured by any standard, it is most surely his song, the loud expression of his vigour and his joy. Both sexes utter this.

Dr. Powers has described at length the love song of a Gray-squirrel, Miriam, that was for some years a member of her furry family; and, doubtless, this represents the song of her kind.

It was mid-winter—the season when the urge sets in—and, in the dawning, perched on a wintry branch, Miriam frankly told her troubles to the world. Whether joy or hanker, the outcry was a loud acclaim, and fell on understanding ears. At first, it was a sharp, insistent, rhythmical cry like the mewing of a Cat; then it rolled forth in a string of "*qua, qua, qua's,*" then quickened into a harsh rattling like the roll of distant musketry. With body tense and quivering tail, she still kept on in variant mood, if variant sound be proof; so soft and tender now the calling, that it was like the mewing of a baby Mouse, the whimper of a song-bird, or "squeak of fairy cottage door." Then, losing sharpness, it died to the soft, sibilant lisp of a twig, wind-rubbed on a larger branch. Then louder again it rose in mews and purrs, and gathering force as her passion surged, turned once more into the rattling cry—a sharp rat-a-tat-tat that found its climax in a final raucous squawk.

Far-reaching, oft-repeated, and convincing is this strange and varied song—not musical, as we may rate it, but sweet music to all those who make or hope to hear it, for it voices the hanker of the love time; and lets the other hankerers know that for their thirst are sparkling springs in sight.

At Greenwich, Conn., on May 12, 1926, about 7 A.M., Mrs. Julia M. Buttree heard outside her house, "Fern Lodge," a Gray-squirrel in full song. On looking out, she saw him about 20 feet up in the hickory tree opposite the window. In the branches all about him as he sang, were over a dozen

English sparrows, sitting listening. One or two of them joined in with a little of their own chirruping, but all the attention was fixed on the vocal Gray-squirrel. Some of the sparrows sat within a foot of him; others were as fai off as 6 feet.

A similar scene is described and pictured in the Chipmunk Life (p. 208.)

Mating

Since the magnificent advertising of the song invariably results in a gathering of males who are would-be-weds, we are not surprised to find that the mating takes place soon after the beginning of the springtime song period.

These troubadour males engage in deadly combats at this time; and, according to Bachman, "bite and wound each other severely."[66] There is, however, no foundation for the story that the conqueror will, in fiendish glee, deliberately hold and emasculate his defeated and helpless foe, and so condemn him to a joyless life, whose ignominy death alone can end.

About the last of the winter—and this, of course, varies from December in the Southern States, to early April in the North—the mating is complete, and all the Gray-squirrels are paired. So that the following note in my journal offers several puzzles:

On June 9, 1912, I heard a great noise among the Gray-squirrels in a red oak near my house. There were 6 large Gray-squirrels chasing each other in great excitement. One or two tried to copulate with a certain one. They streamed up the trunk and along the limbs. At last, one fell from a height of 50 feet. It had a very poor tail, and turned end-over-end in the air, and landed with a heavy flop on top of a board fence. Nevertheless, it seemed uninjured, and was gone when I reached the spot. This seemed to break up the party. Dr. Powers suggests that these may have belonged to the younger set.

Many observers who have studied the Gray-squirrel in captivity are of the opinion that the species is not only monogamous, but that the pair is united for life. I omit their testimony, because it is founded on caged specimens—that is, on unnatural conditions—and give the condensed report of one who for 27 years carefully and minutely studied the Squirrels as wild animals—which, after all, is the only normal condition and proper approach.

Vernon Bailey says that "wild, free Gray-squirrels do not pair, except for a day and a night, or at most two days and two nights, until the female is satisfied and the male exhausted and glad to go away and rest up for the next mate that he can find. The fierce fighting among the males during the beginning of the mating season insures breeding from only the strongest and most vigorous old males. The younger males soon scatter and the old males keep well away from the breeding tree until the young Squirrels are out and getting their own food. Then, if food has been abundant, a second mating for a second brood may take place, with the same old male if he comes back, or with some other."[67]

---

[66] Q. N. A., I, p. 269.

NESTING

During the winter time and early spring, the Gray-squirrel nests in hollow trees or convenient holes in large limbs; but in summer, prefers the built nests or drays. These are masses of twigs and leaves in some high fork, and from a distance, look like the nests of crow and hawk; from which, however, they differ in plan, for they have a waterproof roof, a doorway at one side, and a soft clean bed in the centre. Usually, the Squirrel nest has more twigs, bark strips, and dead leaves, and less large sticks than the bird eyries; but the thatch over it is the surest distinctive feature. Sometimes, the Squirrel uses an abandoned hawk-nest as a foundation.

This built nest is usually in a large crotch of a hardwood tree, or a vine tangle some 20 or 30 feet up; but never in the slender twigs, never near the ground, and never at the tree top, unless it be one of the Northern hemlocks whose tops are a dense mass of dark, sheltering foliage.

The example shown in B (Plate III, p. 39) was in the crotch of a pignut hickory 20 feet up. The forks were only 9 inches apart at the nest. The floor was a solid platform of sweet birch twigs, with buds, but no leaves; therefore gathered this October. The rest of the nest was twigs with large, loose leaves. The walls were about 3 inches thick at the sides next the trunk, and about 6 or 8 at the open places. The chamber was about 5 inches across, roofed with many flat, green leaves of hardwoods, and lined with a little grass and chewed-up bark strips.

Bachman says that the Squirrel "does not descend to the earth in search of materials, finding them ready at hand on the tree it intends to make its temporary residence. It first breaks off some dry sticks, if they can be procured; if, however, such materials are not within reach, it gnaws off green branches as large as a man's thumb, and lays them in a fork of the stem, or of some large branch. It then proceeds to the extremities of the branches, and breaks off twigs and bunches of leaves, with which a compact nest is constructed, which, on the inner side, is sometimes lined with moss found on the bark of the tree."[68]

---

[67] See also Nature Magazine, May, 1925, p. 303.

[68] Q. N. A., I, p. 268.

GESTATION AND YOUNG

After many years' minute observation of her captives, Dr. Powers has definitely determined the carrying period. She writes me: "The gestation of the Gray-squirrel has an average duration of 44 days. This figure was obtained from the births of 4 Squirrels. The longest period was 46 days, the shortest 43 days; the other two were 44 days. One of the 4 was not related to the other 3.

"In *Sciurus vulgaris* of Europe, the period is 40 days."

Merriam says that, in northern New York, the young are born "rarely later than the first of April, and frequently in March";[69] in Arkansas, the first brood is born in February or early March, the second brood in mid-July.

Prof. D. Lange records having found 4 young Gray-squirrels in an outside nest near St. Paul, Minn., April 10th. Apparently, they were born about April 1st. The nest was warm, weatherproof, and perfectly sanitated.[70]

The young number 3 to 5; in rare cases, 1, 2 or 6.

END OF THE BLIND PERIOD

"The average duration of the blind period," says Dr. Powers, "is 37 days. Three Squirrels took 36 days, and two Squirrels took 38 days. One of the 5 was in no way related to the other 4, who were mother, sons, and an aunt."

Thus, from the mating time till the young ones open their eyes, is nearly 12 weeks—4 months—at which time, the young probably weigh a quarter of a pound. In Rabbits, the sum of bearing and blind time is 41 days, or 6 weeks; and the little Rabbits weigh perhaps half a pound. In Dogs, it is a little over 10 weeks, and the puppies weigh perhaps 5 pounds. Thus, there are so many irregularities of rate in this matter, that no rule of development has yet been formulated.

NESTING NOTES

The following notes on the breeding of the Gray-squirrel may fit in with other fragments, and so tell a story:

In the winter of 1921, I set up a roofed keg for a Squirrel nest in an oak opposite my window.

Mar. 21—Fine day. At 6 A. M., saw a Gray-squirrel lying with head out of the nesting box. It stayed so till 7. A sparrow alighted within 5 or 6 feet. The Squirrel leaped out and sat on a limb. Then a man came by, and the Squirrel went indoors.

---

[69] Mamm. Adir., p. 232.

[70] Journ. Mamm., Nov., 1920, pp. 243–44

In evening, saw it again looking out 20 or 30 minutes. It drew back when I went near. Undoubtedly, it is a female with young.

Mar. 22—6:30 A. M., two starlings alighted near the Squirrel nest. One peeked in, when forth rushed the Squirrel and drove them away.

At 5 P. M., she was again at the door. Thus, she is there at sunrise and at sunset, but I never see her go away. What does she feed on?

Mar. 23—Gray-squirrel on duty as usual at her door.

Mar. 25—Gray-squirrel as usual never out.

Mar. 26—Squirrel as usual, but about 5 P. M., saw her run along the stone wall into the woods.

Mar. 27—Gray-squirrel as usual, but for the first time, another adult appeared. It stayed awhile on the next tree, but later went to the high woods.

Mar. 28—Gray-squirrel watching out of the door as usual, but in the afternoon came down the tree, and looked for food on our terrace.

Mar. 29—After sundown, *i.e.*, 6:30, I saw the Gray-squirrel climb the adjoining tree, and leap across to the home tree. Twice I have seen this. It seems to be their cautious habit. Also food left at the foot of the home tree is untouched.

Mar. 30—The Squirrel came down to-day and ran along the wall with a nut in her mouth. So far, has not touched the corn I offered.

Mar. 31—The Squirrel came down at 5:20 P. M., and after an elaborate toilet, went foraging back of the boat house.

Apr. 2—The Squirrel came down as usual, avoiding her own tree, and going as far as possible overhead. She seems to be feeding on red maple blossoms.

Apr. 4—To-day the Squirrel climbed up on the trunk of the home tree. Her feeding times are 6 to 7 A. M. and 5 to 6 P. M.

Apr. 10—This morning the Squirrel came down about 9, and fed on the red choke-berries (*P. arbutifolia*) that grow along the lake front.

Apr. 13—The Squirrel went boldly up her own tree as I watched at 7 A. M.

Apr. 30—For a week or more, I have seen nothing of the Gray-squirrel. Doubtless, she has moved her young, as is their regular custom, on account, I suppose, of the nest becoming full of fleas, or unsanitary. (Dr. Powers writes "I have never known a nest to become 'unsanitary' and have often wondered how it was avoided.")

Aug. 28—The Gray-squirrels hard at work cutting the acorns (red and white oak), even when they plump into the lake.

CARE OF THE YOUNG

The care of the young at this time consists wholly in protecting, keeping warm, cuddling, and suckling. Never, so far as known, does the parent bring home food. "When about 6 weeks old," says Bailey, "the young begin to come out and climb about the tree branches, and eat the staminate flowers of oak and hickory, or the buds and leaves of other trees. When they are half grown and fully furred—that is, about 8 or 9 weeks old—I found that they would eat rolled oats and peanuts, and soon begin on green hickory nuts and acorns."

They are very small and rudimentary at birth; naked, blind, without ears, and with the merest tags for limbs. They are slow of growth; though born in March, it is often mid-May in the Northern States before they first venture forth from the nest.

"At this time," says Bachman, "they may be seen clinging around the tree which contains their domicile; as soon as alarmed, they run into the hole, but one of them usually returns to the entrance of it, and protruding his head out of the hollow, watches the movements of the intruder. In this stage of their growth, they are easily captured by stopping up the entrance of the nest, and making an opening beneath; they can then be taken out by the hand protected by a glove."[71]

From this on, they grow rapidly, their tails fluff out beautifully, and when the inevitable misstep and tumble come, the tail is there in perfection to parachute them gently to the ground.

They stay with their mother until the next brood is about to arrive, when they are generally left in possession of the old home, while the mother finds a fresh nest for her second family.

In the Middle States, this second brood arrives in September, and even October. Kennicott credits[72] the species with a third brood, in the ideal parts of the range, where he observed it. In Massachusetts, E. H. Forbush tells me that two broods is the rule.

Essie W. Williams, of Hudson, Wis., supplies a detailed account of a mother Gray-squirrel moving her blind, naked, almost new-born young from one nest to another, Sept. 3, 1921,[73] evidently a second brood in Wisconsin.

---

[71] Q. N. A., I, p. 268.

[72] Quads. Ill., p. 65.

[73] Journ. Mamm., May, 1923, p. 128.

But in Ontario, where I knew the species best, it was generally believed that one brood each season was the rule of the wild Squirrels. Obviously, then, in that case, there never was any reason for mother to leave the house. Therefore, they all stayed, and made the old family roof tree their headquarters for the winter; until the arousing and disintegrating instincts of springtime made the mother again seek for privacy, and leave the young or send them forth a-gallivanting on their own.

Weather, food, and other conditions modify most of their habits, for Corsan tells me that a captive female in his collection at Toronto produced three broods one season.

There is one remarkable chapter in the history of young Gray-squirrels that has been repeated several times—that is, the raising of a family of orphan Gray-squirrels by their arch-enemy, the domestic Cat.

Merriam relates an instance.[74] George W. Irving of Waterville, N. Y., records another.[75] G. M. Foster, of Glasgow, Ky., gives a third in "The Cat Journal."[76] L. Frank Gunn gives a fourth.[77] The Gunn case differed from the others in that the Cat still had offspring of her own. Probably all of these instances belong to the history, not of the Squirrel, but of the Cat, since she was the heroine of the occasion; and in each case, lovingly raised the foster children that were offered in expectation that she would make a meal of them, and so put an end to the troubles entailed on them by their orphanage.

His Way of Life

If we had an exact record of the performances with which Mother Nature seeks to vary life, we should be as much struck by the daily exactness, as by the seasonal exactness of the wild Kalendar.

The howl of the Wolf is a thing of the night, the yap of the Fox foretells the chill dawn, the peep of day is the time when the Gray-squirrel first leaves his bed high in the high woods, and goes forth, silently at first. It is too cool and repressive for song in this, the early fall, and others of his kind come forth like schoolboys assembling, a little numbed.

But, limbering up with good fellowship and better light, they set out for the favourite feeding grounds. These may be the chestnut or hickory groves at the edge of the timber, or even the ever seductive and much more dangerous orchard and corn-patch suburbs of the thrifty farmhouse.

---

[74] Mamm. Adir., p. 231.

[75] Guide to Nature, May, 1909, p. 70.

[76] Reproduced in Guide to Nature, Dec., 1910, p. 333.

[77] Guide to Nature, July, 1910, p. 110.

Not in a flock, but by general impulse which carries more than a flock, they gallop the long limbs—eight hops and a pause each time—or make the familiar leaps to string along the fences; and even dash over open country till the orchard or the ancient hickory by the barn is reached, and foraging and feeding begin in serious earnest. Reckless, impudent, dare-devil, they seem as they frolic and feast. As Merriam says:

"Everything about this breakfast is thoroughly enjoyed—the early journey to the butternuts, the flying leaps from bough to bough amongst the summits of the lofty elms, the meal itself, and the bit of excitement attending the alarm and escape; each contributes its part toward the pleasure of the occasion. The repast over, the Squirrels do not linger here, but hurry to their homes within the grove. The slanting sunbeam has pierced, but not dispelled, the drop of pearly dew upon the waving grass, when they are already well upon the way. One audacious adventurer, more courageous than the rest, steals down yonder tottering crossfence to the orchard, quickly picks an apple from an overhanging branch, and rejoins his comrades, ere they reach the wood. This haven once attained, all constraint is cast aside, and the cautious, silent, and circumspect Squirrels of a moment ago become the heedless, noisy, rollicking fellows that they really are. . . .

"And when at full speed, they often stop short, clinging head downward to a smooth-barked beech, and utter their saucy, scolding cry—*qua-qua-qua-qua-a, qua-qua-qua-qua-a-a, qua-qua-qua-qua, qua-a-a, qua-a-a-a, qua-a-a-a-a*—in an exasperating impudent tone, keeping time the while with spasmodic contortions of the body and impertinent jerks and flourishes of the large and bushy tail. To observe their utter recklessness during these gambols, one would suppose that nothing could be easier than to approach and shoot the entire troop. Never was man more mistaken. Despite their boisterous manners, their eyes are always open, and they are ever on the alert."[78]

By 9 or 10 o'clock, the objects of the expedition seem to have been fully attained, and the return journey begins. Not at all conspicuous is their back-to-the-woods movement; chiefly, perhaps, because they get back at different times, and by as many different routes as they quietly can. Long before the sun is at full height, these folk of the forest attic, are back in their high home, and enjoying the siesta that seems the normal midday joy of all true sunlight peoples.

And if you be a Squirrel-hunter on murder bent, you may as well do the same, for the noonday Gray is a rare, and maybe, an unhealthy bird.

The heat of the day is over; the chimes of the forest strike four, ere the high climber with the fur-balloon, once more arouses at the call of some wise sentinel of their tribe, and makes a second searching foray after food. Not to the orchard this time—for Silvergray is wise and knows too well the dangers of the farm at such an hour—but through the low woods he scouts; on the ground as much as in the trees. Little there is in flesh, insect, fruit, or nut, that he does not accept as a food gift of the gods. Nor does the waning light impede his work. Sunset itself is only a warning, and many a time, the rustle of his feet have I heard, in the second daily hunt when the shadows were so gray that one found it hard to believe the noise was made by Fanitasho.

---

[78] Mamm. Adir., p. 221.

Bachman says of the Southern race: "It is in some degree nocturnal, or at least crepuscular. . . . We have observed the Carolina Gray-squirrel on several occasions by moonlight, as actively engaged as the Flying-squirrel usually is in the evening; and this propensity to prolong its search after food, or its playful gambols, until the light of day is succeeded by the moon's pale gleams, causes it frequently to fall a prey to the Virginia owl or the barred owl."[79]

Thus, the Gray-squirrel commonly moves around after sundown. One moonlight night, when Sam Warren was out Coon-hunting, he heard a great noise up an oak tree. Nuts and shells rolled down so loudly that he thought there must be two or three Coons up there. He left a boy on guard, then came back at sunrise to find nothing in the tree but 8 or 10 Gray-squirrels.

A neighbour of Warren has a fine hickory tree in his yard, that is stripped every year by Gray-squirrels that come by night. He never sees them there by day.

THE GRAYBACK'S TRICKS

One of the cleverest of this Squirrel's ruses is the "sidling"—that is, gently slipping around the trunk so as always to be on the side away from the gunner.

Merriam, emphasizing the difficulty of getting a shot at these modern Grays, even where they abound, says: "Let someone try to get within gunshot and observe the result. His very approach seems to render them invisible. Those that were near their holes have disappeared within, and the others are hiding behind the trees upon which they were sporting when the enemy appeared. As he advances they rotate slowly about the trunk, always keeping on the farther side so that the body of the tree remains between them. Even if he knows that a Squirrel is on a certain tree, it is doubtful if he gets a shot. A momentary glimpse of its ears or a part of its tail constitutes all he is likely to discover as he walks round the tree.

---

[79] Q. N. A., I, pp. 57–58.

"While watching a bird I once noticed what seemed to be a little tuft of hair protruding from the side of an ash sapling near by. On going nearer, I perceived the object to be the tip of a Gray-squirrel's tail. The animal was clinging vertically to the trunk, hugging it so closely that this bit of hair was the only part visible from the ground beneath, though where he lay the trunk was not four inches in diameter. Not wanting the Squirrel, I fired at the bird, and to my astonishment the former came tumbling headlong to the ground almost at my very feet, an illustration of the effect of terror upon a sensitive animal. He did not tarry long, however, but in a twinkling was off and up another tree."[80]

There is another well-known woods-trick at which the Gray-squirrel is an adept—that is, "freezing." An interesting account of a case is given by Lincoln Wilbar[81] while on a Squirrel hunt when the game was scarce. During a time of dead calm, a sudden tremor shook the top of a near oak tree.

"After that first violent shiver of the branches, however," he says, "I saw no further movement; not a twig stirred. But I have noticed that on these perfectly calm mornings the Gray has a trick of 'lyin' low' in the tree-tops, for some little time after it has disclosed its presence to possible enemies by a leap, as if it reasoned that the shaking of the branch, in such circumstances, was a clue given to the foe. Accordingly, I practised patience, knowing that if a Gray were there, absolute quietness would be most likely to place him at my mercy.

"I waited ten minutes. Then, having neither seen nor heard anything of the Squirrel, I settled my rifle in the crook of my arm and prepared to move on, convinced that some jay or other bird had caused the commotion. It was another case of human patience failing before the animal's. With an unexpectedness that made me jump, a fine Gray-squirrel whisked around the trunk of the tree under which I stood, chuckled loudly at my discomfiture and then leaped into the underbrush, getting away through the thicket to a group of big pines, out of which I was unable to stir it."

Habits in Captivity

Most animals, even men, are tamable if caught young. Bachman says of young Gray-squirrels: "They soon become tolerably gentle, and are frequently kept in cages with a wheel attached, which revolves as they bound forward, in which, as if on a treadmill, they exercise themselves for hours together.

---

[80] Mamm. Adir., pp. 221–22.

[81] Forest & Stream, Jan. 3, 1914, p. 2.

"Sometimes, two are placed within a wheel, when they soon learn to accommodate themselves to it, and move together with great regularity. . . .

"This species is a troublesome pet; it is sometimes inclined to close its teeth on the fingers of the intruder on its cage, and does not always spare even its feeder. When permitted to have the freedom of the house, it soon excites the displeasure of the notable housewife by its habit of gnawing chairs, tables and books."[82]

I have seen one or two Gray-squirrels that were household pets, but not much given to the evil ways described by Bachman.

George H. Corsan is the most enthusiastic Squirrel-man I ever met, and the only one who has succeeded in regularly breeding Black-squirrels in confinement. He has a high opinion of the tractability and docility of the species. Dr. Clyde Fisher also writes me that his pet Gray-squirrel, Billy, never bit or scratched anyone, and showed more affection than any other Squirrel he ever knew.

Merriam calls attention to the remarkable fondness for music, displayed by the Gray-squirrel. "Some," he says, "were not only fascinated, but actually spellbound, by the music-box or guitar."[83]

ENEMIES

The greatest enemy of the Gray-squirrel is undoubtedly the whiteman, armed—not with the rifle, but with the axe. While the great basin of the Mississippi Valley was crowded with nut trees that never failed of a bounteous annual supply, the Squirrel could scoff at the riflemen, be they never such dead-shots.

But when the forest itself was laid low, and the possibility of new generations cut off, the Squirrel hordes were like a river whose parent springs were dried up at the source.

Next after man are probably the hawks. Bachman says: "The Red-tailed hawk seems to regard it as his natural and lawful prey. It is amusing to see the skill and dexterity exercised by the hawk in the attack, and by the Squirrel in attempting to escape. When the hawk is unaccompanied by his mate, he finds it no easy matter to secure the little animal; unless the latter be pounced upon whilst upon the ground, he is enabled by dodging and twisting round a branch to evade the attacks of the hawk for an hour or more, and frequently worries him into a reluctant retreat.

---

[82] Q. N. A., I, pp. 268–69.

[83] Mamm. Adir., p. 224.

"But the Red-tails learn by experience that they are most certain of this prey when hunting in couples. The male is frequently accompanied by his mate, especially in the breeding season, and in this case the Squirrel is soon captured. The hawks course rapidly in opposite directions, above and below the branch; the attention of the Squirrel is thus divided and distracted and before he is aware of it, the talons of one of the hawks are in his back, and with a shriek of triumph the rapacious birds bear him off, either to the eyrie in which their young are deposited, to some low branch of a tree, or to a sheltered situation on the ground, where, with a suspicious glance towards each other, occasionally hissing and grumbling for the choice parts, the hawks devour their prey."[84]

To this Merriam adds an interesting episode: "On the 7th of November, 1879," he says, "I witnessed an exciting skirmish between a goshawk and a Gray-squirrel. The hawk dove repeatedly for the Squirrel, and as often did the latter evade him by quickly sliding around the trunk. He then chippered and scolded and shook his tail in the most aggravating manner imaginable. The hawk was much enraged, but finding himself unable to capture the object of his pursuit, finally alighted to wait till the Squirrel should venture on a limb, a proceeding which the latter wisely showed no inclination to attempt. I put end to the affair by shooting the hawk."[85]

To the list of winged foes we must add the Cooper-hawk and the cat-owl or great horned owl and the barred or hoot owl.

Among quadrupeds, we must list as enemies all the Weasels, the Fisher, Mink, Red-fox, Gray-fox, Lynx, Bobcat, and Wolf, and it is more than likely that the Coon and the Possum will make a meal of the young if they chance to find them in a built nest, while in the helpless stage.

Strange as it may seem, neither the Dog nor the Cat is to be named as a dangerous enemy of the Gray-squirrel.

John S. Fernald of Belfast, Me., writes: "But Squirrels seldom fall victims to either Cats or Dogs; their quickness and ability to run up trees and out upon branches where Cats cannot follow, proving their safety. In fact, I never saw but two Squirrels killed by other animals. One became stalled in deep snow, and the other fell while jumping from one tree to another, and alighted between two Dogs."[86]

Another much-advertised enemy, however, is the Red-squirrel. There is a widespread, ancient, and indestructible myth, firmly established in all backwoods grocery stores, that credits the Red-squirrel, not only with superior physical prowess, so that he invariably drives the Gray from any region desired of both, but also with being possessed of such diabolic intelligence and ingenuity, that he ends every combat with a male Gray-squirrel, by emasculating his defeated foe. It is not necessary to contradict this preposterous myth; but the notion that they are antagonistic is not without foundation.

---

[84] Q. N. A., I, pp. 270–71.

[85] Mamm. Adir., p. 228.

[86] Guide to Nature, Nov., 1908, p. 287.

The Red-squirrel is certainly more aggressive; and in several cases that I have noted, succeeded in driving off the larger Gray-squirrel. It is much like a hawk fleeing before a kingbird—not because he fears its physical powers, but because he hates a row or a fuss, and will make quite large concessions to be left alone in peace.

I have several notes which show the Gray-squirrel as the aggressor; and one in which the Red was forced to abdicate a Squirrel box in favour of his Gray rival.

The pike and the pickerel are known to capture many Gray-squirrels while the latter are swimming across streams.

J. F. Bogan of Centralia, Ill., is responsible for the following: Two friends of his ". . . suddenly came upon a tree in which two Squirrels were engaged in a fight, to death, with a huge black snake. The snake, coiled about a limb, was sparring desperately with the game little Squirrels, who would snap viciously at the intruder and scurry away. Finally, with the rapidity of lightning, the reptile secured a strangle-hold on one of the Squirrels, and its death seemed certain, when its mate dashed boldly at the head of the snake and bit it savagely on the back of the head, inflicting such pain that the snake released its hold on the Squirrel and fell limply to the ground, where it writhed in agony until dispatched by the two [human] spectators. Immediately after their release, the two little animals hastened to the top of a neighbouring tree, where, secure from further harm, they seemed to be enjoying their well-earned victory. The snake measured 5 feet and 2 inches."[87]

F. R. Hodges, of Shreveport, La., records a similar incident; but in this case, ending in the death of the Squirrel, though there was no sign of the Squirrel having been bitten.[88]

INSECT PARASITES

There can be no doubt that insect parasites are more or less of a plague on the Squirrels; and must at times have an important bearing on their health and productivity. I have seen the nest of this Squirrel so infested with insects that evidently the owner had been forced to vacate.

---

[87] Forest & Stream, May 30, 1914, p. 720.

[88] As above, Jan., 1924, p. 28.

The most remarkable foe of the Gray-squirrel is the botfly warble, *Cuterebra emasculator*. The history of the creature is as follows:

In the early '50's, Dr. Asa Fitch, State Entomologist of New York, was frequently informed by the hunters in the vicinity of Lakeville, N. Y., that at least one half of the male Squirrels of all the species found in the country, were castrated. Some thought that jealous rivals of their own species did it, and some blamed the Red-squirrels for all this maiming.

On Aug. 13, 1856, Dr. Fitch received a Chipmunk in whose scrotum was a botfly grub. He says:[89] "I find the fleshy glandular tissue of the testicles wholly consumed, nothing of them remaining but their empty outer skin. . . . There are some hunters, however, that say they have found two grubs in the scrotum of some Squirrels, and they conjecture that it is by these that the testicles are destroyed. . . .

"From what has now been stated, I think that everyone will agree with me in the opinion that it is by this fly that the Squirrels in our country are emasculated."

In 1889, Dr. C. Hart Merriam contributed to "Insect Life,"[90] the following information on the prevalence of this bot:

"In reply to your inquiry concerning the occurrence of *Cuterebra* in Squirrels, I would state that during many years collecting in the Adirondack region of northern New York, particularly along its western border, in the Black River Valley, I frequently found *Cuterebræ* in or near the scrotum in the Gray-squirrel (*Sciurus carolinensis leucotis*), Red-squirrel (*Sciurus hudsonius*), and Chipmunk (*Tamias striatus lysteri*). I have observed the same thing at East Hampton, Mass., and in other localities. The most extraordinary instance of the prevalence of this disgusting parasite that has fallen under my observation, was at the south end of Lake Champlain, N. Y., in Oct., 1885. On the 7th and 9th of that month, I killed more than 50 Chipmunks (*Tamias striatus lysteri*) within a few miles of old Fort Ticonderoga, and on the rocky side hill behind the town of Whitehall. Of these, a very large percentage—I think fully one half—were infested with 'wabbles' (*Cuterebræ*). More females than males were thus afflicted. The 'wabbles' were usually situated near the median line, and anywhere from the umbilical region to the genitals. In a few cases, they were in the axilla, and in one or two instances, in the upper part of the foreleg. In a number of individuals two *Cuterebræ* were found, and in a few cases as many as three."

---

[89] N. Y. State Entom. 3rd Ann. Rep., 1857, Supp., pp. 479–82.

[90] I, p. 215, U. S. Dept. Agri.

Dr. A. K. Fisher tells me that he collected a number of Chipmunks about the south end of Lake George, Warren Co., N. Y., during the latter part of August and first of Sept., 1882, a considerable proportion of which were infested with *Cuterebræ*. As many as three were found, in different stages of development, in one animal. A Gray-squirrel killed at Sing Sing, Westchester Co., N. Y., contained a *Cuterebra* in the left pectoral region.

Dr. Fitch, and most who have followed after him, have assured us that the bot emasculates the host.

Does it? The evidence is far from convincing.

1st. We have proof that a bot develops under the skin of all of our Squirrels. That it often appears in the scrotum of the male, but is as often found in other parts of the body; and in the female as much as in the male.

2d. No trace of the testes is discernible after the development of the grub. Why should there be? For at the season of all observation—August, September and October—the testes are normally reduced to almost nothing, and even, as Bachman says,[91] "drawn into the pelvis."

3d. There is no proof that the bot eats fibrous tissue, or anything but juices.

4th. It is contrary to the known ways of evolution, that any species should develop a habit that would tend to cut off its own food supply.

5th. The final proof has never yet been offered; namely, a male, apparently emasculated by the grub, kept over till next rutting season for observation. I strongly suspect that such males would surprise us, by appearing on time, fully equipped with two perfectly good, satisfactory testicles, that had been safely tucked away in their original nest inside the pelvis; evidencing that the only harm the botfly warble did, was the temporary drain while the host was carrying it. No one yet has reported one of these Squirrels taken in the rutting season of its species, and obviously castrated.

A friend of mine who had the ill-luck to develop a bot-warble in the calf of his leg, tells me that at times, when the creature was turning over, or in some way moving, the irritation was maddening.[92]

The following species are known to be infested by the botfly: Gray-squirrel, Red-squirrel, Eastern Chipmunk, Striped Ground-squirrel, Richardson Ground-squirrel, Franklin Ground-squirrel, Least Vole, Housemouse, Jack-rabbit, etc., as well as most of the Deer family. On Plate XIX, p. 209, will be found a drawing of a Housemouse taken at Winnipeg. It carried three large bots, and was at the point of death.

---

[91] Q. N. A., I, p. 269.

[92] See Vol. III, p. 110.

THE SILVER STORM

The last important enemy of the Gray-squirrel is the silver storm—one of those sudden wintry changes from rain to frost that coat every tree with ice, and render the Squirrel's footing so insecure that he becomes an easy prey for one of the many prowling enemies that are sharp-set by this very weather combination; and which, at the same time, shut the Squirrel off from his own store of buried nuts.

But all of these, the Squirrels could meet, and beat, till man came with his ingenious implements of slaughter, and his ruthless joy in destroying every living thing, without pleasure in its beauty, or a conscience twinge for the desolation of his children's heritage.

AGE

The Gray-squirrel is fully adult in one year, but not full-grown until 2; "is in his prime at 2 to 6, under favourable conditions 8 or 10, and need not show signs of age at 12. They can live until the age of 15 or 16."[93]

On Feb. 5, 1882, at Barker's farmhouse near Toronto, I saw and sketched a tame Black-squirrel that was fully grown when they got it 8 years before, and now it was as young-looking and active as ever it was.

George H. Corsan tells me of a wild Black-squirrel that was well known for 8 years when it was shot by some pot-hunter.

He tells me also of one he captured, a full-grown male Black-squirrel in 1896, and kept it alive for 15 years. It bred every year till 1909; then the female died, after which it did not remate. In the 15th year, it was killed by accident, but was not apparently old; its teeth were all right; a few gray hairs had appeared on its otherwise glossy black back, but in all its actions it was fully alert.

"When aging," says Dr. Powers, "they are subject to cataract. This was observed at the age of 10 in a female Squirrel who developed a cataract on each eye; but during the following years, continued to go about the room as usual, so long as the branches, tree-trunks, tables, and other furniture retained the position she was accustomed to finding them in."

SERVICE TO MAN

In the section that describes the Squirrel habit of planting hickory trees, we have alluded to the great service that Bannertail did in planting the nut forests of America. But that service we must sorrowfully list as a thing of the past.

---

[93] Powers.

The Squirrels value as a source of food, also, is now so reduced that it no longer counts; though all who have tried it agree that Squirrel pie is one of the delicacies that furnish a fitting climax to a long and hungry hunt.

As fur-bearer, the Squirrel never ranked high; and even in these days, when we use everything that, at a distance, looks like fur, the Gray-squirrel pelt fetches but a few cents, and can scarcely find a market.

But there is a larger service than any of these, rendered by the Squirrel in the past, and maybe to be rendered in the future. No one who studies the American victories of the Revolution, both on land and at sea, can question the fact that they were due largely, if not chiefly, to the expert marksmanship of the Colonists. In the War of 1812, it is quite evident, the battle of New Orleans was won entirely by the riflemen; every one of whom was a dead-shot; whereas the foreign soldiers not only were not shots, but did not try to be. Their plan was volley firing in the general direction of the foe, trusting to luck for the hit; and they had no sights on their rifles. It was commonly said that it took his weight in lead to kill an American, while each American ball (90 to the pound) killed a foreign soldier.

Now, what was it that gave the men of the West such deadly accuracy? Unquestionably, it was the Gray-squirrel. These fighters, to a man, were hunters; their daily food was rifle-won. If a man live on venison, as some might, one shot a week may supply him and his family. But what marksmanship can one develop on one shot a week, and at a large mark? Obviously, none at all. The one little target always in sight—small, moving, alert, at everchanging ranges—was the Gray-squirrel and its kin. This it was that furnished the practice and the steady nerves. This it was that trained the armies of the Revolution, that put the sights on their rifles, and the sharpshooter judgment in their brains.

According to Dr. N. E. Jones, when Ohio was threatened with a Confederate invasion in 1862, 50,000 Squirrel hunters volunteered for home defense; and turned aside the danger. They were officially known as Squirrel Hunters; for it was recognized that their training was due chiefly to the Gray-squirrel.[94]

Can we ignore the lesson? Can we question the wisdom of fostering the Gray-squirrel numbers to the maximum that agricultural interests will permit?

It is the easiest game animal to restore, it does little harm to property.

---

[94] Squirrel Hunters of Ohio, 1898, p. 341.

it affords all the needed practice to develop riflemen for national security; and at all lawful times, it supplies to the city man, the farm-boy, and the sportsman, the most alluring motive for a glorious tramp in the ever-inspiring woods, with a sufficiency of material reward, an amplitude of present joy, and a heritage of delightful memories.

References

1842—American Natural History, by Dr. John D. Godman, I, pp. 342–45.
1849—Quadrupeds of North America, by Audubon and Bachman, I, pp. 265–76.
1857—Quadrupeds of Illinois, by Robert Kennicott, U. S. Pat. Off. Rept. for 1856, pp. 62–67.
1884—Mammals of the Adirondacks, by Dr. C. Hart Merriam, pp. 219–32.
1896—Review of the Squirrels of Eastern North America, by Outram Bangs, Proc. Biol. Soc. Wash., Dec. 28, pp. 145–67; figs. 29–32; Pl. VIII–X.
1899—North American Arboreal Squirrels, by Dr. J. A. Allen, American Naturalist, Aug., pp. 635–42.
1919—Mammals of Wisconsin, by Hartley H. T. Jackson.
1923—Mammals of the District of Columbia, by Vernon Bailey, Proc. Biol. Soc. Wash., May 1, pp. 103–38.
1925—The Carolina Gray-squirrel, by Vernon Bailey, Nature Mag., May, pp. 303–06; 3 ills.

LIFE LXIII—CALIFORNIA GRAY-SQUIRREL

PAGE
Names 60
Description: Size, Weight, Colour 60
Races 60
Range, Haunts, and Home Range 61
Food 61
Voice 62
Nests 62
Mating and Young 63
His Way of Life 63
Diseases 65
His Worth 66

References 66

ESCAPING THE HAWK

California Gray-squirrel, West Coast Gray-squirrel, Western Gray-squirrel, Gray Tree-squirrel

Sciurus griseus Ord

(L. *Sciurus*, see *ante;* L. *griseus*, gray)

Sciurus griseus Ord, 1818; Journ. de Phys., Vol. 87, p. 152.

Type Locality—The Dalles, Wasco Co., Ore.

Wintun Indian of N. Calif., *Tí-tcel-is* (Townsend).

Its huge, bushy tail, and clear, blue-gray colour, stamp it with a character that is unmistakable; even on the ground, which it so much affects. In the West, there is no other Squirrel like it in these particulars.

My own acquaintance with it is limited to a few occasions while I camped in the Sierra foothills in 1899. It seemed to me exactly like our Eastern Gray-squirrel, but of a clear blue-gray colour, and with an immensely long tail.

To the generic characters, it adds the following:

Size. Total length, $22\frac{1}{2}$ in. (571 mm.); tail, 11 in. (280 mm.); hind foot, $3\frac{1}{16}$ in. (79 mm.).

Weight. About the same as that of the Gray-squirrel, *i. e.*, 1 lb.

Colour. All above, of a soft pepper-and-salt gray, inclined to leaden; eye-ring, dull white; all below, clear white; tail gray, sprinkled with black, and with white edging and tip. Compared with the Eastern Gray-squirrel, it is notably clear of the washes of rusty brown.

Races

Three races have been recognized:

griseus Ord, the typical form. T. l., The Dalles, Ore.

nigripes Bryant, a dark brownish race, with feet nearly black. T. l., Coast region, San Mateo Co., Calif.

anthonyi Mearns, a pale form, often tinged with yellowish on back; with upper surface of the feet intermediate in colour between the two foregoing; though the form is not intermediate in range. T. l., Laguna Mts., San Diego Co., Calif.

RANGE, HAUNTS, AND HOME RANGE

Its range is clearly set forth in Map I, p. 12. A comparison with forestry maps shows that it is a creature of the heavy timber, and especially of the pine and oak forests.

This is a mountain species, because its favourite food trees grow only in the mountains. It ranges from 4,000 to 8,500 feet above the sea, adhering closely to those localities where pines, or oaks and pines, abound. In these, it finds its staple foods; for these it will, however, descend into the foothills much lower than the altitude given above.

Concerning the home range of the individual, we have no information. But it is likely to be, in extent, like that of its Eastern relative.

FOOD

Like its congeners, it eats the nutlets of the various cone trees, acorns of all kinds, and nearly every species of seed in its range. So far, it has not been recorded as feeding on insects, nor been convicted of birdicide.

Stephens expresses the opinion that it does not store up quantities of food.[1] That is, I take it, it has the same storage habits as the species *carolinensis*.

Bachman writes: "A large part of its food consists of nuts [of sugar pine] which are stuck in hollows or holes bored in the pine trees, by a species of woodpeckers called by the Californians 'sapsuckers.' These nuts are placed in holes in the bark, which are only so deep as to admit the nuts (which are placed small end foremost in them), leaving the large end visible and about flush with the bark; they thus present the appearance of pins or pegs of wood stuck into the trees, and are very curious objects to the eye of the stranger."[2]

On Sept. 26, 1899, while coming with camp outfit down from the High Sierras, a dozen miles west of Calaveras Big Trees, we noticed that the Chipmunks disappeared as the live oaks were reached. Here also we saw the old fight on between the "Jacobs" (as our guide called the California woodpecker from its note) and the Tree-squirrels. We saw many dead trees with serried beds, whose holes were plugged with acorns, one in each. These were the caches of the woodpecker; and, in defence of them, they waged continuous and noisy warfare on the Gray-squirrels.

---

[1] Calif. Mamm., p. 88.

[2] Q. N. A., III, p. 265.

VOICE

J. E. Clements, who supplied Bachman with material for his account, says that this Gray-squirrel barks somewhat in the same tones as its Eastern relative, but ceases at once when it finds itself discovered by a man. "Sometimes they seem to be excited to the utterance of their cries by the whistling of the California partridges, which, near the hills, approach the edges of the pine woods."[3]

Its calls are like those of the Eastern Gray-squirrel. "The 'bark' is a series of hoarse notes rapidly uttered, which can be heard a considerable distance."[4]

NESTS

The nests are much like those of the Gray-squirrel of the East; and the hollow-tree den, when one can be found, is no doubt preferred for use in cold weather.

Stephens considers that the outside nests are used in most cases for the nursery;[5] which would imply that the young are born during warm weather.

The nests of this Gray-squirrel are placed at such inaccessible heights that they have been but little observed; therefore, a contribution from the pen of Tracy I. Storer is highly acceptable.

While in the hills near Lake Lagunitas, Marin Co., Calif., April 13, 1919, he examined a number of tree nests, some of which were the work of the Brown-footed Woodrat, but most of them made by Gray-squirrels, as attested by the smaller size, more rounded, compact shape, and greater height from the ground.

"In the Sierra Nevada," he says, "nests of the Gray-squirrel are more often placed in conifers; but in the coast redwood belt, the animals use the live oak, California laurel, and madrone. The nest discussed here was about 40 feet above the ground in a live oak, just within the crown of green leaves at the top of the tree. It came to attention only when the tree was examined from directly beneath. The nest tree was in a grove of live oaks on a slight rise of ground between two rather level small valleys.

"This nest was about 50 centimetres [20 inches] in outside diameter. The form of the base of the nest suggested that it might originally have been constructed by a Western crow, a bird which is common in many parts of Marin County. There were portions of several flight feathers of a crow in the nest, but these could well have been picked up on the ground by the parent Squirrel when gathering material for the nest lining.

---

[3] Q. N. A., III, p. 265.

[4] Calif. Mamm., p. 88.

[5] As above.

"The central soft portion of the nest was about 25 centimetres in diameter [10 inches]. At the bottom, it was made up of shredded oak bark, prepared by the parent Squirrel in the manner common to many rodents; and much of this material was in very short lengths. Above this, was a soft mass of gray lichen, chiefly *Usnea florida*, but with some *Evernia prunastri* and a slight amount of a moss *Alsia longipes*. Over the moss and lichen were some live-oak twigs cut green, to which the leaves were still adhering. In the central soft part of the nest were the two young Squirrels where they could easily keep warm while the female was away."[6]

MATING AND YOUNG

Analogy leads us to suppose that the mating takes place in January; that the species pairs, and may be monogamous.

According to Stephens, the young are born at any time from April to August—which probably means that they have two broods each season; although he says that, in his opinion, only one brood is the rule.[7]

The young in one brood range from 1 to 4; 2 and 3 being the most frequent numbers. When born, they are, like others of the group, very small and rudimentary.

Storer's account of the nest, already quoted, is followed by remarks on the young. He took them home, and tried to rear them on condensed milk and water; but they survived only 3 or 4 days. They seemed sensitive to cold, and uttered an impatient squealing at the slightest chill. As they were energetic feeders, there can be little question that a mother Cat would have adopted them successfully. These young were male and female, probably over a week old when found. Two days later, the male weighed 74.6 grammes and was 8¼ in. long; the female a little larger.

HIS WAY OF LIFE

In habits, this bright, vivacious cousin of our Gray is the embodiment of grace and agility. If anything, it is nearer to the Fox-squirrel in its terrestrial habits; for, according to Stephens, it runs "about on the ground a great deal, ordinarily preferring to travel on the ground rather than through the tree-tops."[8]

---

[6] Journ. Mamm., Aug., 1922, p. 188.

[7] Calif. Mamm., p. 88.

[8] As above.

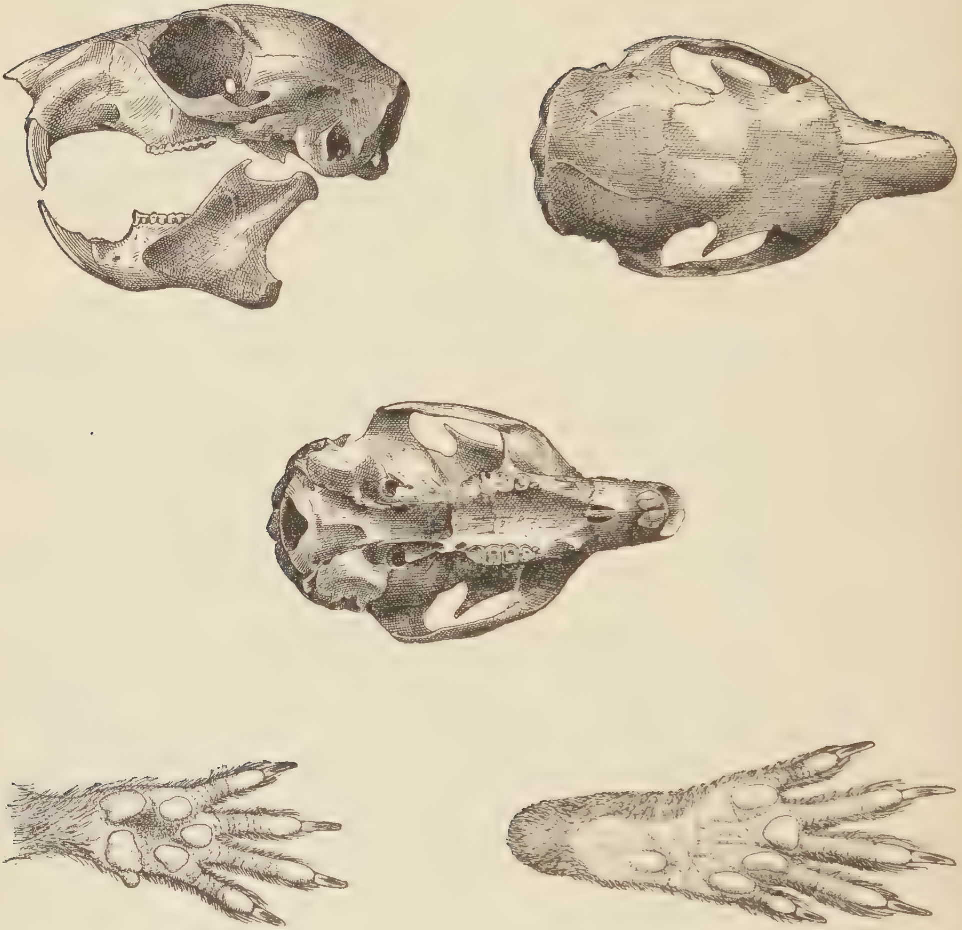


PLATE VI.—DETAILS OF WESTERN GRAY-SQUIRREL (*anthonyi*)

Skull and feet of right side, about ⅔ life size. These cuts are from Mearns's *Mammals of the Mexican Boundary*, supplied by the U. S. National Museum

Bachman writes: "It is exceedingly swift on the ground, and will not readily take to a tree; or if it does, ascends only a few feet, and then jumping down to the ground, runs off with its tail held up, but curved downwards towards the tip like that of a Fox when in flight.

"By the aid of a fast cur-dog, it may, however, be put up a tree. In this case, it hides, if a hole offers in which to conceal itself; and unlike some others of the genus, seldom leaps from one tree to another over the higher boughs in the endeavour to make its escape."[9]

The same authority describes it as a roving animal, and adds: "One may sometimes see from one to a dozen in a morning's hunt in the pines, and again not meet any. They very seldom leave the pines; but are occasionally seen in the dry season, following the beds of the then almost empty water-courses, which afford them, in common with other animals and birds, water and such roots and grasses, as they cannot find on the uplands at that period of the year."[10]

A curious observation is made by Charles H. Townsend:[11] "In winter," he says, "the males of this species appear to gather in groups; and in Shasta County, in January and February, I have frequently shot half a dozen out of one tree, as fast as I could load and fire. Females seemed never to be present in these bands."

The species does not hibernate; but in stormy weather, may remain in the nest for several days without food, exactly as does its Eastern counterpart. In fine weather, even with deep snow on the ground, it runs about, foraging with the utmost vigour.

DISEASES

"They seem to be subject to epidemics and irregular fluctuations in abundance," says Stephens.[12]

Referring to the Squirrels in Plumas National Forest, A. J. Stanley writes: "During the season of 1913, many became diseased, and died. This frightened many people out of using them for food, and as a result very few are now killed. It is not uncommon to see 30 or 40 in a single day."[13]

This protection, though unintentional, had the usual effect of increasing their numbers. But other consequences are recorded by Stanley as follows: "Gray-squirrels are so thick in this district of the Plumas National Forest that very few pine or fir cones have been allowed to ripen and disseminate seed for the past three years, since the Squirrels destroy or eat up the crop while in a green condition."[14]

---

[9] Q. N. A., III, p. 265.

[10] As above.

[11] Field Notes, p. 174.

[12] Calif. Mamm., p. 88.

[13] Cal. F. & G., April, 1916, p. 112.

Next, probably on account of this overpopulation, the inevitable epidemic appears. In this case, it was an outbreak of mange or scabies. This skin affection, caused by mites of the genus *Notoedres*, apparently broke out in the El Dorado National Forest, Calif., in 1917, and played havoc for a time among the Squirrels of that region. A brief account is given by H. C. Bryant.[15] Further details appear in the same publication for Jan., 1922.[16] To all appearances, the plague was still prevalent in 1924. In 1926, Squirrels were scarce in the Yosemite, and the disease continued epidemic in some places.[17]

HIS WORTH

The Squirrel does little harm to crops, is good eating, and is a prized game animal. The sum total of which observations shows that it is a close parallel of our Eastern Gray-squirrel; is, indeed, the same creature translated into terms of a West Coast environment. But it always seemed to me a far finer animal; for its coat is clearer blue-gray and white, its tail a much longer plume, and its value in the landscape far above that of its yellow-brown relative.

REFERENCES

1849—Quadrupeds of North America, by Audubon and Bachman, III, pp. 264–66.
1887—Field Notes on the Mammals, Birds, and Reptiles of Northern California, by Charles H. Townsend, Proc. U. S. Nat. Mus., p. 174.
1906—California Mammals, by Frank Stephens, pp. 86–88.

---

[14] Cal. F. & G., April, 1916, p. 112.

[15] As above, April, 1921, p. 128.

[16] P. 52.

[17] As above, Oct., 1926, p. 205.

LIFE LXIV—TASSEL-EARED SQUIRREL

PAGE
Names 68
Description: Size, Colour, Melanism 68
Races 69
Range and Haunts 69
Numbers and Migration 70
The Silver Plume 70
The Tufted Ears 71
The Pine-wood Echo 72
Mating and Nests 72
Bearing and Young 74
His Way of Life 75
Freezing 76
Food and Food Rivals 77
An Appraisal 79

References 79

Tassel-eared Squirrel, Tufted-eared Squirrel, Abert's Pine-squirrel, Saddle-backed Gray-squirrel, Black-squirrel, White-tailed Squirrel, Silver-tail

Sciurus aberti Woodhouse

(L. *Sciurus*, see *ante; aberti*, in honour of Col. J. J. Abert, who in 1845–46 explored in its range)

Sciurus aberti Woodhouse. 1853, Proc. Acad. Nat. Sci. Phila., Vol. VI (1852), p. 220.

Type Locality—San Francisco Mt., Ariz.

Hualapai (North Ariz.), *Ma-qui-hi-ta* (Mearns).
Hopi (Northeast Ariz.), *Scha-ghern-uh* (Mearns).

When seen alive in its native range, its large size, bushy tail, blue-gray colour, white underparts, and white under side of tail, are distinctive; so also the ear-tufts, if it be in winter.

To the generic characters, it adds the following:

Size. Total length, 19⅝ in. (500 mm.); tail, 8⅝ in. (220 mm.); hind foot, 2⅞ in. (73 mm.). Ears in winter, with an upright tuft of blackish hair, more than an inch long; these are absent in late summer.

Colour. All above, soft leaden gray, except the saddle, which is reddish brown; all below, white, including the under side of tail; tail above, gray and black, with black tip. On the sides of the body, a black stripe, separating the gray of the upper parts from the white of the under. The ear-tufts are at first black, but fade in early summer to brown, before being shed.

Melanism. Dr. Mearns found only one melano or black coat among the hundreds that he saw in central Arizona.[1] In Colorado, on the other hand, it illustrates the "extreme melanism among mammals," 19 out of 24 Colorado specimens in the national collections being melanistic, while out of nearly 100 killed in Estes Park, Colo., only one was gray.[2] Thus it resembles the Eastern Gray-squirrel in being chiefly melanistic in the North, and rarely so in the South.

---

[1] Mamm. Mex. Bd., p. 252.

[2] Biol. Surv. Colo., p. 67.

On account of its likeness to the Old World Squirrels, Dr. Mearns suggests[3] that this species, like the Little Chipmunks (*Eutamias*), is of Asiatic origin; though why it should not be the other way about, does not appear.

Races

Seven races have been recognized:

aberti Woodhouse, the typical form. T. l., San Francisco Mt., Ariz.

ferreus True, like *aberti*, but without the red on the back, and with tail mixed gray on both sides. T. l., Loveland, Larimer Co., Colo.

mimus Merriam, like *aberti*, but much paler, with the red saddle small or wanting. T. l., Hall Peak, Mora Co., N. M.

phæurus Allen, a Mexican form, like *aberti*, but red on back very dull, and not reaching the base of tail; tail, gray above, grizzled gray below, and edged with white. T. l., La Cienaga, N. W. Durango, Mex.

barberi Allen, a Mexican form, like *phæurus*, but tail white below. T. l., Colonia García, Chihuahua, Mex.

durangi Thomas, like *aberti*, but much less chestnut on back; tail and ears, smaller and narrower; lower surface of tail, uniform grizzled gray. T. l., Cuidad Ranch, 100 miles west of Durango City, Mex.

kaibabensis Merriam, like *aberti*, but underparts mainly black instead of white, and tail mainly white all over. T. l., Bright Angel Creek, north side of Grand Canyon, Ariz. This is considered by some authorities a kindred but separate species.

Range and Haunts

The range of the Tassel-ear, so far as known, is shown on Map I, p. 12, but this may possibly be modified by fuller investigation. Its area corresponds exactly with that of the yellow pine forests of the dry Southwest. It does not occur in the spruce belt, that is, the Canadian Zone of the region.

Its congenial surroundings are the pines, between the altitudes 5,000 and 8,000 feet; rarely up to 9,000. Thus, it will be noted, it affects haunts much like those chosen by the West Coast Gray-squirrel; the most obvious difference being the greater amount of rain in California

---

[3] Mamm. Mex. Bd., p. 251.

Numbers and Migration

Dr. Edgar A. Mearns, who has contributed so much to our knowledge of this superb creature, says that it is very plentiful in Bill Williams Mountains, generally abundant in the wooded mountains of Arizona; and so abundant in Mogollon Mountains between Forts Verde and Apache, that his men with their carbines shot 11 from a single pine, and 47 were eaten by his party in that one camp.[4]

Along the Mexican boundary, it is so scarce that Mearns failed to find even one.[5] In Colorado also, it is reported scarce.[6] So that its chief abundance is in the high central forest of New Mexico and Arizona, about the middle of its range—quite the usual thing.

Of course, like all its kin, it fluctuates greatly in numbers. "Some years," says Nelson, "they are extremely numerous, and are in evidence everywhere; again they become scarce, and so wary that it is difficult to see one, even where its fresh workings are in evidence."[7]

These fluctuations are measures of the total population; for there is no indication of any great migration, the nearest approach to it being found in Cary's suggestion that in Colorado "possibly this Squirrel lives at a higher elevation in summer than in winter."[8]

"At times," says Mearns, "this Squirrel is somewhat gregarious. Frequently an entire family may be seen running together upon the ground, or a half dozen enjoying a frolic in a pine tree."[9] As already noted, Mearns collected 11 out of one pine tree; but, strange to say, all were males. This appears to have been in late May, which is the rutting season—a curious mixture of events.

The Silver Plume

Gregarious animals, especially if also sociable, have usually a high development of directive marks and apparatus; while solitary animals seem more in need of protective colours and devices.

The present is both sociable and slightly gregarious. So far as one can see, it has no protective colouration at all; and is not only coloured for

---

[4] Mamm. Mex. Bd., p. 253.

[5] As above, p. 251.

[6] Warren; also Cary, various pp.

[7] W. A. N. A., p. 565.

[8] Biol. Surv. Colo., p. 65.

[9] Mamm. Mex. Bd., p. 352.

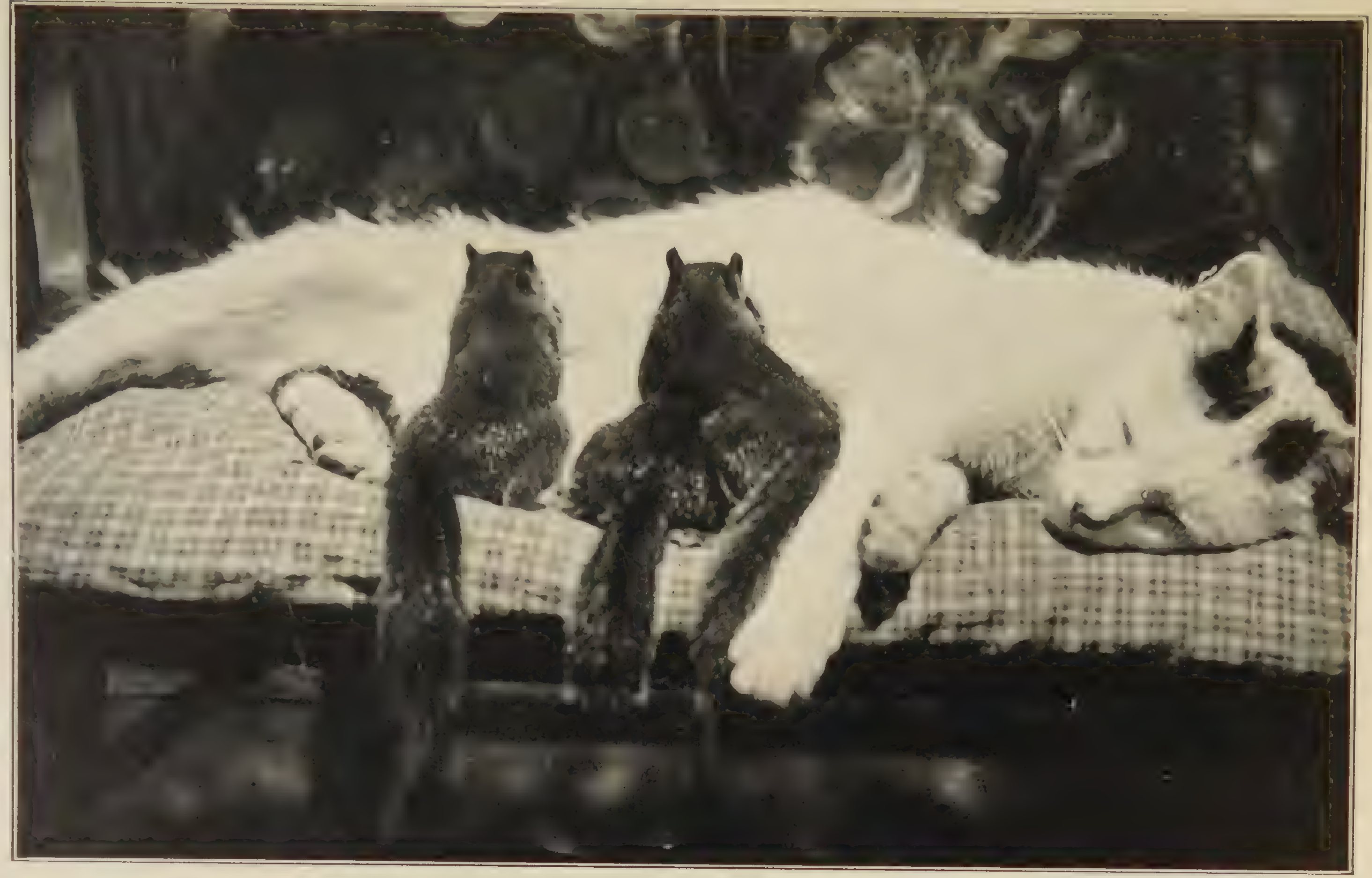


PLATE IV.—A FOSTER MOTHER. CAT AND YOUNG GRAY-SQUIRRELS

Photograph by Geo. W. Irving, Waterville, N. Y.

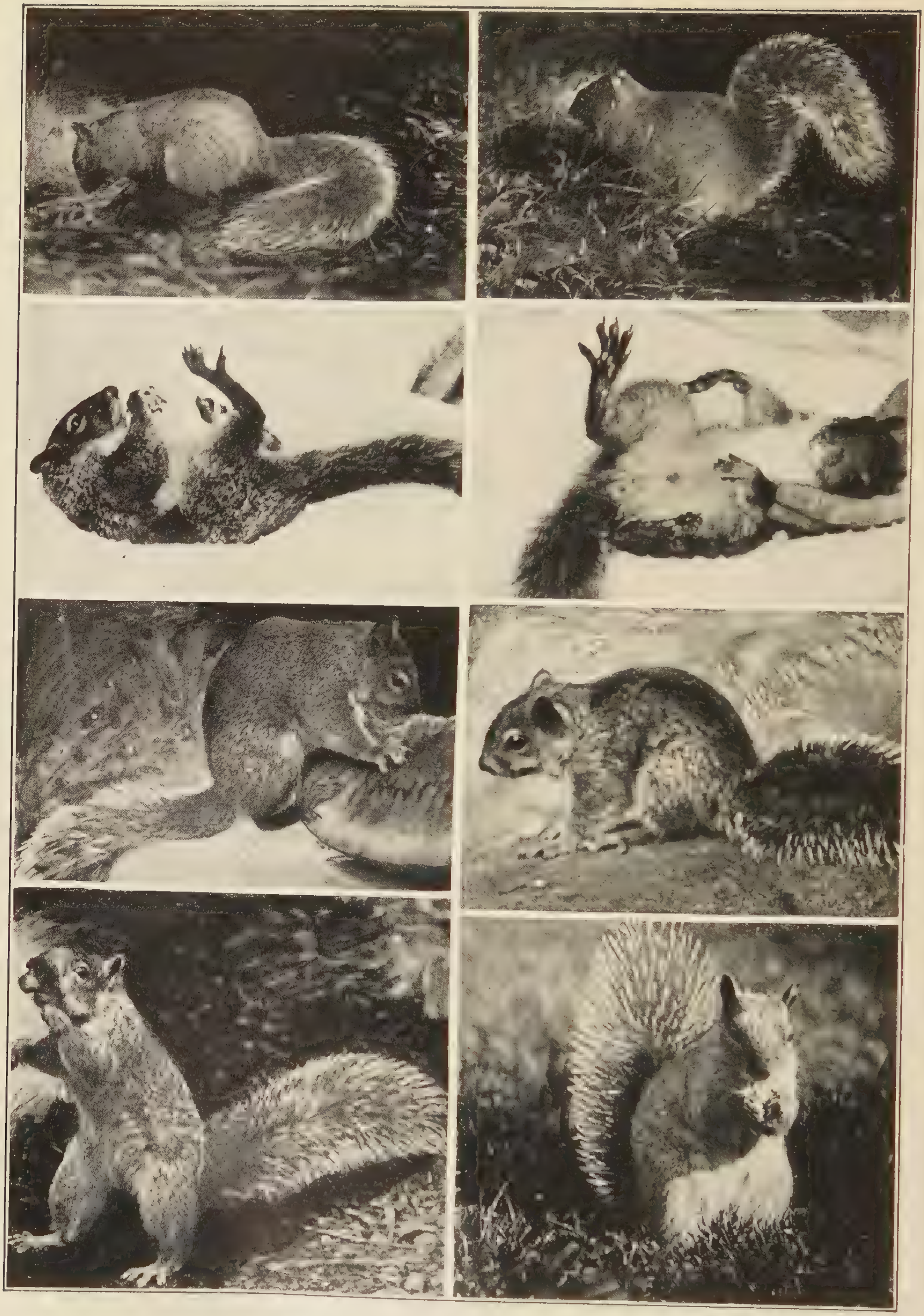


PLATE V.—GRAY-SQUIRREL POSES

Photographs by Dr. Clyde Fisher

identification, but has two exaggerated features—the tufts on the ears, and the enormous tail, which is white below in the typical *aberti*, and white all over in the wonderful Kaibab race.

It is, like all tree Squirrels, expert in hiding behind the large limbs or trunks of trees, when alarmed; and when hidden, will sit patiently "an hour or more" according to Nelson, waiting for the danger to pass, but, he adds, "is often betrayed by the wind blowing the feathery tip of its tail into view.

"On the ground, the tail is usually carried upraised in graceful curves. Here these Squirrels spend much time among fallen cones, and in digging for roots and other food. When they walk, they have an awkward waddling gait; but when they are alarmed or desire to move more rapidly for any cause, they progress in a series of extremely graceful bounds, which show the plumelike tail to good advantage. When the Kaibab Squirrel is moving about on the ground, its great white tail is extraordinarily conspicuous in the sunshine. This repeatedly drew my attention to these Squirrels, even at such long distance that they would otherwise have been overlooked."[10]

This same naturalist describes the leap of one which he observed close at hand. "On one occasion," he says, "a branch on which an Abert Squirrel was standing near the top of a pine tree, was struck by a rifle ball; the Squirrel promptly ran to the end of a large branch about fifty feet from the ground, and although no tree was anywhere near on that side, leaped straight out into the air, with its legs outspread just as in a Flying-squirrel. It came down in a horizontal position and struck the ground flat on its under side, and the rebound raised it several inches. Without an instant's delay, it was running at full speed across a little open park, and disappeared in the forest on the other side."[11]

The Tufted Ears

The remarkable ear-tufts of this species may be considered directive marks—label signals—so that others of the race may recognize him afar. But we are confronted by the puzzle that they are absent all summer. They first appear in September, as short, glossy black hairs, projecting from the tip of the ear. They grow steadily till January, when they are commonly an inch and a half long. From this time, their length continues unchanged, but their colour bleaches; in spring, they are brownish; in May, they are faded, thin, and poor; and by the first of July, usually entirely dropped, leaving the ears much as in a Fox-squirrel.

---

[10] W. A. N. A., p. 565.

[11] As above, pp. 565, 568.

The Pine-wood Echo

The species is gifted with its own version of the typical Squirrel calls and cries, chatters and scolding notes. Its loud "*qua-a*" is said by most observers to resemble the bark of the Eastern Gray-squirrel; but Cary describes it as a "soft bark, sometimes sounding like 'wuh-wuh-wuh,' and again like 'chuck chuck chuck'; [it] is usually repeated three or four times at short intervals, and each call is accompanied by a jerk of the tail." In the silence of the vast forest vistas, he adds, "the calls of this squirrel are, at times, the only sounds which reach the ear."[12]

"These Squirrels," says Nelson, "have a deep churring or chuckling call, sometimes becoming a barking note resembling that of the Fox-squirrel. They also have a variety of chattering and scolding notes when excited or angry. At times, they become almost as aggressive as the Red-squirrel, and come down the tree trunk or to a lower branch, whence they scold and berate the object of their disapproval."[13]

Mating and Nests

The mating season in Arizona is in May when "whole troops of males are commonly seen chasing the females."[14] Whether it pairs or not, is uncertain.

The nests of the northern form, *ferreus*, are nearly always constructed of pine branches; and lined with needles, and strips of the inner bark of the pine, or with grass.

Writing from Colorado, Cary says: "The nest tree—usually a large dead pine with a hollow sufficiently large for the Squirrels' home—is generally located in the heaviest forest, and very few of the animals live in small timber or along the outskirts of the forest. A few nests, composed largely of dry pine needles, were seen in the upper branches of large pines, but most of the Squirrels appeared to be living in hollow trees."[15]

The nests are placed in the forks of the trees, or often in the abandoned nest of some large bird. Mearns says: "When in the San Francisco forest, early in June, I heard some long-crested jays scolding with their usual spirit in a pine tree. On walking to the spot, I saw a nest and began climbing the tree. When halfway up, the owner of the nest, which proved to be an Abert Squirrel instead of the long-crested jays, passed me, coming down, on a neighbouring trunk. We both stopped, when about to pass, and took a look at each other. I felt a supreme disgust at my taxidermic productions when I looked at the living creature within a few feet of me. The Squirrel had taken forcible possession of the jays' unfinished nest, and had built a round nest upon it, composed entirely of clumps of wire-grass, pulled up by the root, having an entrance at the sides."[16]

---

[12] Biol. Surv., Colo., p. 69.

[13] W. A. N. A., p. 565.

[14] Mamm. Mex. Bd., p. 253.

[15] Biol. Surv. Colo., p. 68.

Near Ganado, Ariz., Aug. 24, 1927, assisted by Carol Stryker, I examined two nests, which were respectively 50 and 20 feet from the ground, each in the crown bunch of yellow pine.

The first was found by Stryker to be as follows: Floor, walls, and roof, a solid mass of yellow pine twigs, most of them a foot long and up to $\frac{3}{8}$ of an inch in thickness. Outside, it was 18 inches across, and about 12 inches high. The chamber was 7 inches wide and 4 inches high, softly lined with finely shredded fibres, apparently of yucca stalks. It was approached by a tunnel 4 inches in diameter and on the south side. This began under a porch that was 6 inches across. There was also a north exit that was but 2 inches wide. In spite of recent heavy rains, the nest was dry and warm inside; also it was quite clean and without parasites.

The other nest was similar. On page 79 is a sketch of this.

In the Eastonville region to the northeast of Colorado Springs, where the altitude is low, and the fauna Transition, Cary found it living entirely in open nests. "But," he says, "near Bradford [which is Canadian or even Hudsonian], it is said often to take up its abode in hollow pines, and even in hollow cottonwoods"[17]—precisely as its Eastern relatives often do—the open nests for warm weather, the hollow trees for cold.

---

[16] Mamm. Mex. Bd., p. 253.

[17] Biol. Surv. Colo., p. 67.

Bearing and Young

Nothing definite is known of the term of gestation in this Squirrel.

The young number 3 or 4. "A female," says Mearns, "taken on the summit of the Mogollon Mountains, May 27, 1887, contained 3 young; and 3 and 4 fetuses, respectively, were found in the uteri of two specimens taken at Pine Tanks, at the lower border of the pine forest, 30 miles north of Fort Verde, on June 19 of the same year."[18]

The young are brought forth at any time between April and September, the time varying somewhat with the altitude, so that it is probable that two litters are commonly raised in a season.

At Baker's Butte, Mearns found the young were running in the trees by the middle of July, which leaves ample time for the second brood in the season.[19] And Dr. Hartley Jackson writes me: "I saw young of similar age at Baker's Butte in the middle of September."

Nelson has given a delightful picture of Squirrelet individuality, as well as of this creature's home life. He says:

"One summer day in the Sierra Madre of western Durango, I sat on a mountain slope watching for game. Below me stood the hollow-topped stub of an oak, the top being on a level with my eyes, and about 20 yards away. Soon after I arrived, the heads of four half-grown Squirrels of the Abert family appeared in a row at the upper border of the opening, their bright eyes turning on all sides. Suddenly a hawk glided by, one of its wing-tips almost brushing the noses of the Squirrels. Instantly they vanished from sight, and a noise of scratching and frightened chattering continued for several minutes, as though they were burying themselves under the nest.

"About twenty minutes later, the boldest of the family showed the tip of his nose at an opening in a hollow branch near the top of the stub; but it required another ten minutes for him to venture forth his head. Finally, becoming confident that no danger threatened, he came out on the limb, and deliberately stretched himself, yawning as widely as his little mouth would permit; after which he flirted his tail and frisked over to the trunk of the stub, where he began frolicking about with all the abandon of a kitten at play. When I departed, his more timorous companions were still peering fearfully out of the hole, anticipating the return of the dreaded hawk."[20]

---

[18] Mamm. Mex. Bd., p. 254.

[19] As above, p. 254.

[20] W. A. N. A., p. 568.

His Way of Life

Dr. E. A. Mearns's account of this royal creature of the great pine woods is so good and so completely lost to the general public by being buried in a Government report, that I quote at length from it:

"The Abert Squirrel is quite certain to attract the notice of even the most indifferent observer travelling through the wooded mountains of Arizona, where it is generally abundant and seldom shy. I first met with it on one of General Crook's expeditions, which I accompanied in 1884; when it was found in abundance in the Mogollon Mountains, between Forts Verde and Apache. It was noted as soon as we entered the pine forest. The first one was seen running along upon the grassy turf. It 'treed' after a brief pursuit, and was shot in the lower branches of one of the superb pines which are the glory of the Arizona forests.

"Thenceforth it furnished the hunters of our party with sport, and agreeably supplemented our daily fare; indeed, under the régime of a clever camp cook, it proved to be the favourite dish, although the menu included venison, Bear meat, turkey and pigeon, variously served. . . .

"If not molested, this Squirrel is quite gentle, and its habits easily observed; but, when thoroughly frightened, it is an adept at hiding. It would seem that its bushy tail, white beneath, would betray its whereabouts directly; but it can flatten itself out upon the upper side of a limb so adroitly as to be hard to detect, even when the eye has chanced to fall directly upon it. If fired upon, it often betakes itself to the tree-top, clinging motionless to the topmost bough, where it is often so far above the ground as to be beyond the range of shotguns, and not apt to be discovered.

"These mature pine forests, unlike the spruce woods, are quite open, the trees being often too scattered to allow the Squirrels to pass from the branches of one tree to those of another, and frequently they are obliged to descend to the ground in order to reach a neighbouring tree.

"If intercepted by a horseman in its passage from one tree to another, it will stop and flatten itself upon the ground, and watch the rider; and I have known it to allow itself to be struck with a whip rather than deviate from the course it meant to pursue. Seizing a favourable opportunity, it dashes for the tree which it originally intended to climb, and seeks concealment and safety among its lofty branches. It seldom enters holes in the trunk or branches of the pines; but prefers, when pursued by its natural enemies, to trust to its dexterity in whisking around to the opposite side and then hiding."[21]

---

[21] Mamm. Mex. Bd., pp. 252-53.

Cary's account of the parent Squirrel and the nest suggests the unsophisticated ways of Squirrels who know no worse enemies than Wolves and Foxes. "It is often first detected," he says, "on the ground, moving about among the pine cones which carpet the forest floor in many places. When alarmed, it lopes leisurely up to the base of a pine, usually the nest tree, which it seems reluctant to climb, barking and scolding at the intruder until approached somewhat closely. When thoroughly frightened, it betakes itself to the higher branches, and its claws make a very audible sound on the dry bark. When seated motionless on an exposed limb far up in a big pine, this Squirrel presents an odd appearance, due to its long hairy ear-tufts. Once safely within the confines of the nest tree, it will occasionally scamper part way down the trunk in a daring fashion, chattering excitedly. In climbing up or down a tree, it spreads its feet far apart, and by its flat appearance reminds one strongly of a Flying-squirrel."[22]

"This species," says Mearns, "is active throughout the year, but inclined to lie quiet during heavy storms and severely cold winter weather"[23] —in which it resembles every other tree Squirrel in America.

It will be noticed that Mearns, in 1884, described this Squirrel as coming fearlessly to feast in numbers about his camp. But this was in the primitive forests of Arizona; and the usual persecution has effected the usual change.

Writing some 30 years later in Colorado, Cary says: "The Squirrels themselves were very quiet and shy, and were seldom observed; and not a single sound was heard which could be attributed to them. I hunted carefully for the larger part of a day before catching sight of one."[24]

FREEZING

In the section on the "Silver Plume," we have noted that Nelson credits the creature with freezing "an hour or more." It was my privilege to witness a performance that continued three times as long. On August 24, when the Woodcraft Expedition of 1927 was camped near Ganado, Ariz., we were aroused at sunrise by the loud barking and quarrelling of two Abert Squirrels. On rushing forth, we found them in a tall yellow pine. One disappeared; the other froze on the top of a 4-inch limb. He was in plain sight, but absolutely still.

The whole camp was aroused. We photographed and sketched him to our hearts' content, then measured the height of the tree by triangulation,

---

[22] Biol. Surv. Colo., p. 68.

[23] Mamm. Mex. Bd., p. 254.

[24] Biol. Surv. Colo., p. 67

(it was 94½ feet) and yet he kept his pose unchanged. During this time he slowly moved his head down to the limb and up again once. In his teeth, he held a small cone; this he cautiously laid between his forefeet, then as slowly took it up again.

We continued our watch, then tried to move him by throwing stones. A flock of 6 pigmy nuthatches came and played around him, still he kept his perch.

During this long and neck-wracking spell, we relieved each other in watching. The camp bustled below, but he gave no sign of interest.

After 2 hours and 20 minutes, he suddenly but slowly turned himself to head the other way, and so continued for 53 minutes more. That is, he never moved from the spot for 3 hours and 13 minutes. Suddenly, he flashed out of sight into the thick foliage above.

What a complete concealment such freezing is against an ordinary hunter!

Food and Food Rivals

"Its food," says Mearns, "consists mainly of the seeds of the pine, acorns of the deciduous oaks, groundnuts (*Aralia*), and green vegetation in summer. I once saw one running in the trail ahead of me, carrying a very large white mushroom in its mouth. I halted to watch it, when it ascended a pine tree and began eating the mushroom voraciously.

"By the latter part of July, the pine cones have nearly attained their full size, and the seeds are sufficiently mature for the Squirrels to begin feeding upon them. Under every prolific pine visited by this Squirrel, green chips from the cones may then be seen lying, together with the central cores. The hunter can often locate the Squirrels by observing the chips as they come whirling down from the trees, and by the sound made in tearing the cones in pieces.

"I have never seen the Abert Squirrel engaged in hoarding up food, and suppose that it leaves the morrow to care for itself. The stores preserved by the provident *carpintero*, or Mexican woodpecker (*Melanerpes formicivorus*) are appropriated by it whenever found; and beyond doubt, these caches relieve it at times from extremities of want when the ground is deeply covered with snow and the pine cones mostly fallen or divested of their seeds.

"The Mormon settlers of Pine Creek informed me that the Abert Squirrel commits some depredations on their crops of Indian corn, eating both green and ripe ears, but that it does much less damage than the Rocky Mountain Line-tailed Ground-squirrel (*Citellus grammurus*)."[25]

---

[25] Mamm. Mex. Bd., p. 254.

Describing its food habits in Colorado, Cary says: "The forest floor for a considerable radius around the nest trees was generously sprinkled with fresh green cuttings of branch tips, pieces of gnawed bark, and freshly peeled twigs; while a few of the upper limbs of the trees were gnawed and peeled in places, much as if by Porcupines. . . .

"A stomach examined at Pagosa Springs contained a mass of finely masticated green material which could not be identified with certainty, but probably consisted of the inner bark of the terminal branches of the yellow pine. One Squirrel was seen gnawing the bark from a good-sized limb, apparently feeding. The many freshly cut tips of terminal branches beneath the pines in the neighbourhood of the nest trees, attest to the Squirrels' activities."[26]

Nelson says: "The seeds and the tender bark from the terminal twigs of the yellow pine (*Pinus ponderosa*) furnish their principal food supply. . . .

"The Abert Squirrels also eat the seeds of Douglas spruce, of the pinyon pine, acorns, many seeds, roots, green vegetation, mushrooms, birds' eggs, and young birds. Now and then they rob cornfields planted in clearings, but they do little damage to crops."[27]

"I suspect," says Mearns, "that the Abert Squirrel sometimes interferes with the nests of birds. On July 21, 1886, when camping near Flagstaff, Arizona, a pair of Western robins had established themselves in a young pine tree close by, the nest being placed about 20 feet above the ground. One morning, there was a great outcry from the birds, and I found them furiously assaulting a large Squirrel, which they drove away, whereupon I completed their victory by shooting it.

"In May, 1887, a smart contest between a pair of red-backed juncos and an Abert Squirrel was witnessed near Mormon Lake; and I have also seen fierce attacks made upon this Squirrel by infuriated long-crested jays, whose jealousy of intrusions about their premises is always conspicuous.

"The Mexican woodpecker and Abert Squirrel have unending and vociferous quarrels and feuds over the latter's propensity for pilfering from the hoards of nuts stored in the pine bark of the busy woodpecker, and scold, berate, and belabour each other soundly."[28]

Dr. Mearns finishes his charming account of the Tassel-ear's springtime song with an anticlimactic note on the excellence of the creature from the kitchen viewpoint. "They were first parboiled," he says, "and then fried in batter. The flesh is light and delicate."[29]

---

[26] Biol. Surv. Colo., pp. 66–69.

[27] W. A. N. A., p. 565.

[28] Mamm. Mex. Bd., pp. 254–55.

AN APPRAISAL

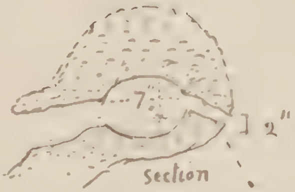
It is our duty to turn this antipanegyric into a worthy appreciation by pointing out that this is really a fundamental thought, for considered with the foregoing accounts of this as one of the largest and most beautiful tree climbers, in one of our noblest forests, it completes its qualifications as a high-class game animal; and for these many reasons worthy of careful preservation.

REFERENCES

1907—Mammals of the Mexican Boundary, of the United States, by Dr. Edgar Alexander Mearns. U. S. Nat. Mus. Bull. 56, Pt. I, pp. 250–55.
1910—Mammals of Colorado, by Edward R. Warren, p. 183.
1911—Biological Survey of Colorado, by Merritt Cary, N. A. F. 33; pp. 64–69.
1918—Wild Animals of North America, by E. W. Nelson, pp. 564–68.

---

[29] Mamm. Mex. Bd., p. 253.



Tassel-ears nest
Ganado
Ariz.
24 Aug. 1927.

LIFE LXV—FOX-SQUIRREL

PAGE
Names 82
Description: Size, Weight, Colour 82
Races 83
Range and Home Range 84
Numbers 86
Haunts 86
Food and Appetite 88
Foods Brought by Man 90
Storage 91
A Black Chapter 92
Den, Nest, and Sanitation 93
Mating 94
Young 95
Ground Habits 96
Shy and Retiring 98
Amusements 99
A Squirrel Hunt 99
Proud and Lazy 100
His Time o' Day 101
Use of the Banner Tail 102
Voice 103
His Enemies 103
His Claim to Protection 105
Age 106

References 106

FOX-SQUIRREL

Fox-squirrel, White-nosed Black-squirrel, Yellow-bellied Squirrel, Big Red-squirrel, or Red-tailed Squirrel

Sciurus niger Linnæus

(L. *Sciurus*, see *ante;* L. *niger*, black)

Sciurus niger Linnæus, 1758, Syst. Nat., ed. 10, Vol. I, p. 64.

Type Locality—Probably southern South Carolina

Choctaw, *Fanakla*.
French, *le Coquallin* (Buffon); evidently contracted from the Mexican, *Cotztiocotequallin* (Hernandez); *le Capistrate* (F. Cuvier).

When seen in the woods, its large size, bushy tail, white nose and ears, make it easy to distinguish; that is, in the area that on Map II is marked *niger*.

But in the much larger area of *rufiventer*, the identification is different; for there, the common race is gray above, with rufous, or dull orange, underparts and tail. The orange tail will distinguish it from the Gray-squirrel in regions where both are found, except in melano or black coats; but the black Fox-squirrel is confined to the South, the black Gray-squirrel to the North.

To the generic characters, it adds the following:

Size. Total length, average $25\frac{1}{8}$ in. (638 mm.); hind foot, $3\frac{7}{16}$ in. (87.8 mm.); tail, 12 in. (304 mm.). When adult, it has but 4 cheek-teeth on each side of the upper jaw (the Gray-squirrel has 5). Thus, it is a more highly specialized form than the Gray.

Weight. A Michigan female in my collection weighed $2\frac{1}{4}$ lbs., and I have heard of specimens nearly 3 lbs. in weight. Thus, it is not only a larger animal than the Gray, but also much stockier and heavier. In the Southwest, it is of less weight than in the North. Specimens secured at Austin, Texas, Nov. 6, 1920, weighed ♂ 1 lb. 9 oz., ♂ 1 lb. 6 oz., ♀ 1 lb. 6 oz. However, Florida specimens are the largest of all.

Colour. The form first described, and therefore the typical one, is the Black-squirrel of South Carolina—all over of a deep, glossy black, excepting the ears and nose, which are always white.

Nevertheless, in the same region, and quite as numerous, are two other colour phases—the buff and the gray. In the buff, the upper parts are pinkish buff; the underparts, feet, and underside of tail are of rich, warmer buff. In the gray, the upper parts and tail are gray; underparts, white; the crown is black; the nose, ears, and feet, white.

These three phases grade into each other.

But the real Fox-squirrel, the fox-coloured one from which the species gets its popular name, and which therefore, in a popular sense, is typical, is the big, orange-breasted form of the Mississippi Valley. All above, it is of a pepper-and-salt gray; the face, paws, underparts, and tail are of a rich reddish yellow or fox-colour; the long hairs of the tail are banded alternately with black and orange, so that, from below, there is one broad black band near the tip; and above, it is sprinkled black and brown with an edging of clear yellow all around.

This is the normal colour style in the Ohio region, but the variations are numerous. Some have all the lower parts red, some have them black, some have the head more or less black.

Any large Tree-squirrel in North America east of 100° meridian, with white nose, may be safely set down as a Fox-squirrel; so, also, any yellow-breasted Tree-squirrel north of north latitude 35°, and any black Squirrel south of the same latitude belongs to this species.

The list of colour variants is further increased by the occurrence of albinos. They are found in all parts of the range, but are not very common.

The winter pelage is practically the same as that of summer.

RACES

Five races have been recognized:

niger Linnæus, the typical form, as above. T. l., South Carolina.

rufiventer Geoffroy, gray above, foxy yellow below; never with white nose or ears. T. l., Mississippi Valley.

neglectus Gray, a large form, much like *rufiventer*, but of paler colours and usually with the belly white. T. l., Wilmington, Del.

texianus Bachman, a large, dark form, similar to *rufiventer*, but nose and ears white (though less extensively than in *niger*), and head with some black; tail, deep tawny; belly, either tawny or whitish. T. l., Coast of Louisiana or Mississippi.

limitis Baird, smaller and paler than *rufiventer*; upper parts, buff, grizzled with black; belly, pale yellowish buff. T. l., Devil's River, Valverde Co., Texas.

avicennia Howell, decidedly smaller than *niger*, and much darker and more tawny; feet clearer white. T. l., Everglade, Lee Co., Fla.

bryanti Bailey, similar in colour to the pale gray phase of *niger*, but without black patch on head. T. l., Dorchester Co., Md.

Range and Home Range

The range of the species is very definitely the great hardwood forest of Eastern North America. It coincides almost exactly with Sargent's map of the oak forest, in which are 10 or more species of oak—that is, the Eastern States south of latitude 43°, and east of longitude 100°. But it does not agree with the range of the hickories and chestnuts.

Outside of this, are the following records:

Massachusetts, where, according to E. Emmons, it was found in 1840, but "not very common."[1]

The three northmost records for *Lower Michigan* are in the counties Charlevoix, Cheboygan, and Presque Isle. Those in the Upper Peninsula are in counties Luce and Chippewa.[2]

Dr. J. A. Allen gives Fort Randall, So. Dak., as a Western record.[3]

Map II (p. 85) gives the primitive range. We are forced to acknowledge a considerable shrinkage to-day, particularly in the Northeast. It is probably exterminated in New England and New York; very rare in New Jersey and Pennsylvania. The race *neglectus* is now rare and probably approaching extinction.

William Palmer, of the National Museum, told me that in 1915, the Fox-squirrel was still found in the country around Washington, D. C., and in the swamps of the Patuxent River, Md. In the summer of 1914, as he canoed down the Potomac, he saw 5 or 6 in one day; they were among the vine-draped trees of the river bank. A. H. Howell tells me that in 1926, it was still found on the Patuxent.

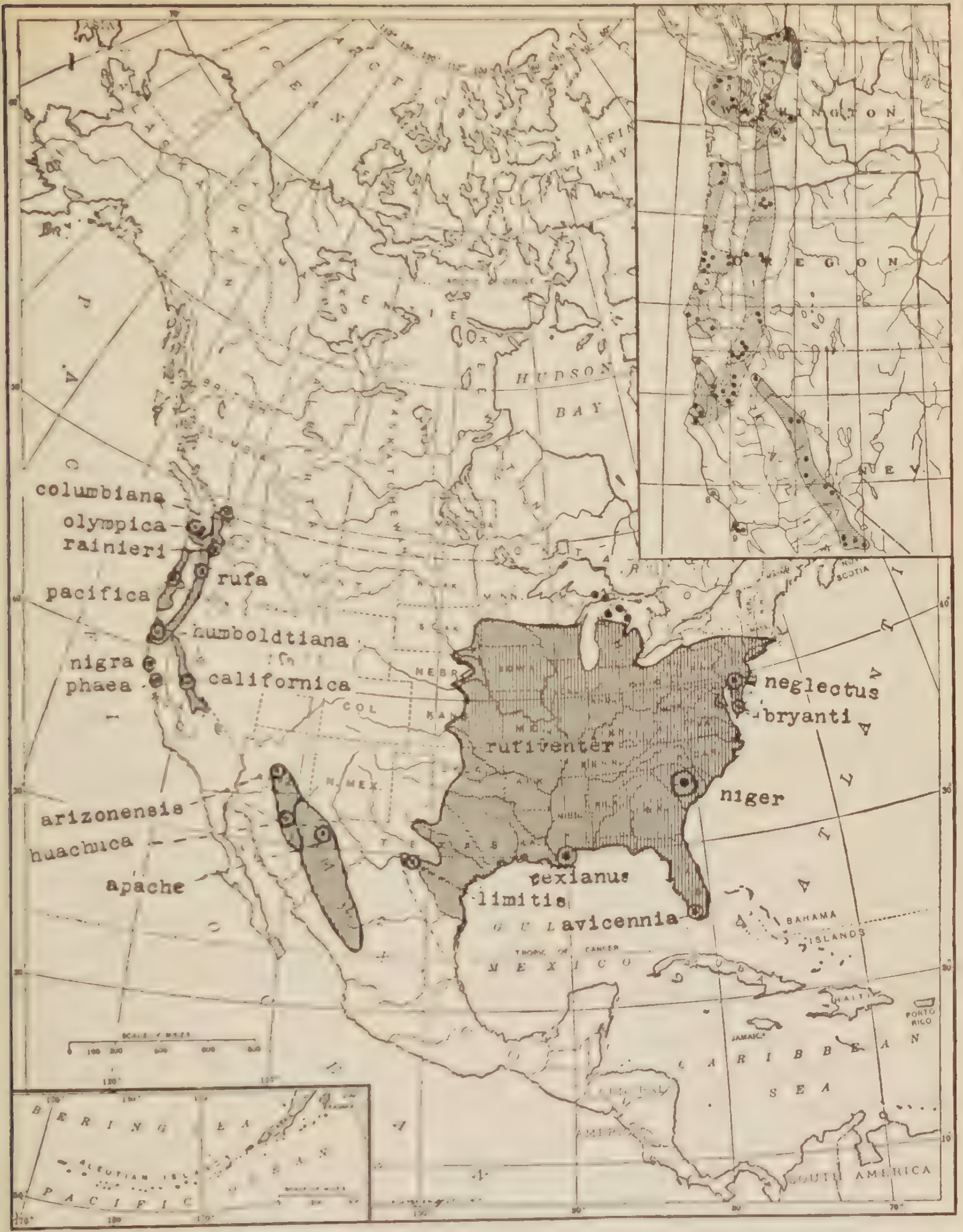
Arlington Cemetery had always been a haven of Fox-squirrels. About 20 years ago, they had increased to surprising numbers. Then, one day, they seemed to be possessed of a migration craze; they all set out eastward. At once, they were met by the broad Potomac; but plunged in, swimming away toward Analostan Island, the nearest wooded tract. Here many of

---

[1] Quads. Mass., 1840, p. 66.

[2] Norman A. Wood, Annotated check list of Mich. Mamm., Univ. Mich., April 1, 1914, p. 4.

[3] Monog. N. A. Rodentia, 1877, p. 720.



MAP II. RANGE OF THE FOX-SQUIRREL, AND OF ITS RELATIVES, THE APACHE AND ARIZONA SQUIRRELS

On the West Coast, is the range of the Mountain Beaver. The inset map of Mountain Beaver is from W. P. Taylor's Monograph, and is contributed by the University of California.

By E. T. Seton, with assistance of the Biological Survey, 1927

them stayed; but many moved on, and were lost sight of. They still frequent Arlington Cemetery.

"It is becoming scarce in many parts of the South."[4]

In those parts of the Mississippi Valley where it continues, its numbers are greatly reduced.

It was never found native in any part of Canada.

In the *Canadian Field Naturalist* for Sept., 1925, p. 138, is recorded an attempt to introduce the Fox-squirrel on Pelee Island, Lake Erie, Ont. Charles Mills, of Sandusky, O., brought some Fox-squirrels from southern Ohio, and set them free on Pelee in 1893. They became plentiful; but later dwindled; and since, have wholly disappeared.

The home range of the individual must be very small—not more than 20 acres under ordinary conditions, and probably much less than that of the Gray-squirrel. Of half a dozen that I turned loose in Wyndygoul Park, in the spring of 1901, but one was seen as far off as a half mile from the original spot, and two that died some weeks after, were found within fifty yards of the place where they got their liberty. The others disappeared.

NUMBERS

It is even harder to estimate the primitive numbers of the Fox-squirrel than those of the Gray. From all accounts, this species was always much less numerous—perhaps as one to ten of the Gray. And yet, Bachman tells us that, when the corn in the fields was green and tempting, it was customary for gunners to guard it from these red marauders. "In this way, thousands of [Fox] Squirrels are destroyed during the green corn season."[5]

In the account of Squirrel abundance in Missouri (given in the Gray-squirrel Life, p. 26), on the authority of John B. Thompson, of Chicago, a large proportion of them were Fox-squirrels, especially in the hill country. It is not unusual for a gunner to get 40 or 50 Fox-squirrels a day even yet.

Nevertheless, there is no evidence that the present species ever migrated in vast armies, as did the Gray.

HAUNTS

It is quite sure that the environment created the animal; for it was there first. It was the mould into which the plastic animalism was poured, and from which it took all its colour, form, size, properties, and propensities. Obviously, then, no two species can have the same environment, or they would be the same species. At a casual glance, the Gray-squirrel and the Fox-squirrel make the same choice of surroundings; but a careful study shows that they have little in common, outside of certain foods. Their range, in the large sense, is different.

---

[4] Howell, Distribution, p. 59.

[5] Q. N. A., II, p. 136.

In detail, the Gray is a thick-wood creature, the other a borderland species. The Gray lives chiefly in the trees; the other, half its time on the ground. Finally, as to times and seasons, the Gray is a very early morning and late evening species; while the Fox-squirrel avoids both extremes, and goes about only when the sun is high, and the Gray-squirrel home in bed. The Fox-squirrel loves neither the low-timber lands of the Gray, nor the deep pine woods of the Red-squirrel. It is by choice an inhabitant of groves of timber interspersed with open country. The oak "islands" of all the Middle-western States that lie between the forest and the plains, are ideal for the Fox-squirrel, as also are the belts of timber that skirt the streams of the prairies. The "oak islands" have increased in number since the settlers have put an end to the annual devastation of prairie fires; and whenever it happens that a thrifty grove of oaks has sprung up around some gnarled and hollow old patriarch, it furnishes a combination that is sure to attract a pair of the Red-tailed Squirrels. For its island character keeps interlopers away, the grove supplies abundant food, and the hollow oak a central citadel —a refuge from all manner of foes, as well as a lookout and sunning place in times of peace. Kennicott points out the special value of the pin-oak in such groves; for it not only feeds the Squirrel, but by retaining its leaves all winter, affords shelter from hostile eyes, as well as weather.

This preference for an open space is so marked in the species, that, according to Kennicott, "the Fox-squirrel loves to take up his abode in a hollow tree which stands out alone at a little distance from the surrounding timber, as if desirous of having a clear view of all going on around him. When he once becomes domiciled in a tree, he does not leave it, unless disturbed; pairs being observed to inhabit the same tree for five or six successive years."[6]

A somewhat different habit is imposed by the different surroundings of the far South. Howell writes me that "*S. niger niger* in Florida and the Carolinas inhabits the open forests of long-leaf pine (*Pinus palustris*), ranging also into the borders of the cypress swamps. *S. niger avicennia* lives in low, wet swamps of black and red mangroves."

George L. Fordyce furnishes additional testimony in line. He tells me that during his early days in central Ohio, especially about Youngstown, Gray-squirrels were abundant, and Fox-squirrels unknown. Fox-squirrels were first seen in the region about 1880. After that, they steadily increased, while the Grays disappeared. At present (1919) one can easily find 10 Fox-squirrels a day, while the Grays are practically gone with the virgin forests.

---

[6] Quads. Ill., p. 60.

These facts are reflected in the map, the dense Fox-squirrel population being in the scattered timber; and if we had exact observations, they would probably show the species as wholly absent from such primitive forests as those of Michigan, Ohio, Kentucky, and Tennessee.

All of this, it will be seen, is in contrast to the habit of the Gray-squirrel, which is a tall-timber, thick-wood Squirrel, never happy away from the trees, and taking to them immediately on alarm.

Food and Appetite

We may list the foods of the Fox-squirrel under three heads—primitive, man-supplied, and morbid.

In the primitive woods of the happy days "before the whiteman came," its standard and ideal fare was nuts and seeds of trees—hickory nuts of all kinds, walnuts, butternuts, chestnuts, beech mast, acorns bitter and sweet, basswood nuts, elm seed, maple and ash seeds, the stones of wild cherries and plums, and seeds of all conifers in its range.[7] It would, indeed, make a shorter tale if we listed those it will not eat, rather than those it does.

These seeds and nuts are at hand chiefly in the season of abundance. There are other seasons when the Fox-squirrel is hard put for a meal. This is often the case in late winter. The delectable hickories are long gone, the cups of the oaks are empty, and the pine cones are gaping wide. Every berry-bush has been searched over by birds with eyes and weapons as good as those of the Squirrel. The nuts he buried here and there in the ground last fall, have been dug up, or are frozen beyond reach. He has not, and never did have, a sinking fund of capital—a hoard of nuts in a hollow tree. He is confronted now with a healthy appetite, an empty belly, and a forest gleaned of its last and poorest nut.

If the ground has little or no snow, he works hard—searching, smelling, scratching, turning over every pile of leaves and every flake of fallen bark, for nuts or seeds. But be it noted, though so much of a ground forager, he rarely eats on the ground—he carries the food to a neighbouring log, stump, even a low tree, to enjoy at his leisure. Often he may in this way discover and rob the cache of some Deermouse; and continually, he comes across dormant beetles, insects, and grubs of the forest kinds. He is known to feast on these when he must, and they are known to abound in such places. So that the weeks of February, the Hunger Moon, are in part provided for.

---

[7] A number of fresh specimens given me near Austin, Tex., Nov. 6, 1920, had the stomachs distended with a fine mass of ground-up fruit of the cedar-elm (*Ulmus crassifolia* Nutt.).

If the ground is deeply buried in snow, he must look higher for his food, climbing after the still hanging seeds of bitter-sweet or other vines; or still higher, searching over trunks and limbs of every rugged tree, scratching under the loose bark, and minutely trying out each cranny for grubs or bugs of any kind. But the birds have been over it all long before, and few indeed are the prizes likely to reward such search.

The last resort of all destitute woodland creatures—always at hand—is the browse, buds, twigs, and bark of such sweet-tasted trees as elm, maple, sweet birch, and basswood. Oh, how well did we youngsters in truant schoolboy days know the sweet aromatic mucilage of those fragrant trees! I only hope the Squirrel does not pay in belly-aches as we did for the pleasant mouthing of an hour before.

But the Squirrel's digestion is better fitted to such food than ours—he flourishes on it. The abundant fat he carried last nut-time is wasting—nearly gone. However, he weathers the storm; and March, the Wakening Moon, eats up the snow, and sends the sap up-coursing in the trees again. The swelling buds are better fare than ever now, and the sap itself is an acceptable food. Red-squirrels, Gray-squirrels and Fox-squirrels, all are known to count on this. They know as well as we, which is the sugar-tree. The Fox-squirrel in particular has a taste for sap. With his chisel teeth, he girdles the tree at some safe point, and rejoices daily in the flowing sweetness.

Kennicott speaks of having seen 15 or 20 Fox-squirrels licking away at a single oak, thus girdled.[8]

But the bare ground once more opens a large field for forage. The thrifty little hoarder buried thousands of nuts last fall—some of them are sure to be there yet. His sagacious nostrils will always take him to the very spot. There are treasures, too, that he did not bury. The bog potato (*Apios*) is abundant; and there are many frugal plants whose surplus earnings of last year are stored up as little bulbs and roots. These are good food, they are near the surface, and Redtail's nose is an unerring guide. So that the problem of March is more easily met than that of February.

In April, the number of succulent shoots with buds and bugs is vastly increased. A little later, the seeds of elms and maples, then the berries and fruits of summer—raspberries, strawberries, haws, etc.—are ample for his sustenance; till prodigal autumn, with her overabundance, sets the Squirrels a-rioting once more; frolicking, feasting, gathering and hoarding away, in a thousand one-nut holes for the rainy days ahead.

---

[8] Quads. Ill., p. 59.

Foods Brought by Man

This is, so far, a sketch of food habits in the primitive woods. But such exist no longer, and the largest variant in the Squirrel diet of to-day is the blessed Mondamin, the corn of the settlers, the king of the prairie farms. Guided by scent, or rumour, or we know not what, the Fox-squirrel seems to know exactly when the corn in the field a mile away is planted; and repairs thither whensoever it is easier to get a meal in that way than, for the thousandth time, combing his own homestead.

But the planted seeds are well down, and hard to find; so that little harm is done.

It is a different matter when, weeks later, the grape-vine telephone of the woods whispers that the corn is now in the milky stage that spells heaven to all living creatures with normal appetites and discriminating palates. Redtail then hies him to the field of the tasselled plumes. He has not the least intention of dashing in for one short. sweet orgy followed by an early and hasty retreat. Not at all. He is here for a good time, and has no idea of cutting it short. Reasonable precautions he will take, but that is all. In some crotch whence this land of milk and honey can be easily seen, he builds a comfortable platform nest. Here he sprawls contentedly between his feastings, and takes his sun bath in the morning. Then, having spied out the land again, having seen that those night marauders, the Coons, have gone back to the woods, and noted that the crows—those super-vigilant, self-appointed sentries—have signalled "All well," he ventures down to fill his round belly bigger yet, with another glorious feast, that never palls and never brings a headache in its train.

Kennicott's picture of the Redtail and his methods is complete: "Not only does he thus eat the corn on the stalk, but he gnaws off whole ears, which are never eaten on the ground, but always carried off to the fence, or to a neighbouring tree, where, perched upon a flat rail or large limb, he discusses them at his leisure. Sitting up on his hind feet, he tears off the husk, and pulls out the kernels with his teeth; and if the corn is in the milk, all the soft part is eaten; but when ripened, he often lays down the ear, and, holding the kernels in his paws, only gnaws out the germ. Along fences, or under trees, situated in or near cornfields, thus attacked by Squirrels, husks, cobs, and partly eaten ears of corn may frequently be found. Sometimes, when Squirrels are molested, they do not stay near the field to eat the corn, but carry the ears off to some distance in the woods. I am informed that when the crop of mast is scanty, large cornfields have been destroyed in parts of Illinois and Indiana by this and one or the other of the two species next to be described [Gray and Black Squirrels]; while fields in these localities are more or less injured every year, especially if bordered by timber, or with a few old trees standing in them, in which the Squirrels can take refuge; as they venture with less fear into these fields than into those at a distance from their congenial refuge."[9]

The great damage to the corn seems to be only while it is green. Later on, there are so many wild foods, that, apparently, the Squirrels have small interest in the fields, and the corn suffers but little. For the same reason, the other grain crops are scarcely molested by the Redtails.

STORAGE

The Fox-squirrel, like the Gray-squirrel, stores up food for the winter; never in hollow trees or in great quantities at any one place, but in hundreds or thousands of little pockets under the leaves or in the ground. In these pockets, the Squirrels store nothing but nuts—never even corn—and usually but one nut in each place. During all the fat autumn days of plenty, the Squirrels work just as their Gray cousins do, salting down food in abundance. There can be little doubt that one Squirrel will hide literally thousands of nuts; and a thousand nuts, if he can recover them, are a fair supply for a year.

On Aug. 1, 1903, I watched for an hour, the Fox-squirrels in City Park, Madison, Wis. A large male, that seemed master of those near, came forward as I offered him some peanuts. The first three he ate, the rest he buried. His procedure was the same each time: seizing the nut in his teeth, then in his paws, he turned it two or three times in his mouth, and appeared to be licking it. Why? I could not guess, unless it was to mark it with the smell of his ownership. (This trick is also practised by the sailors and small boys of our own race, as well as by the Eskimo of Davis Strait. Franklin says: "The fortunate person licked each article with his tongue, on receiving it, as a finish to the bargain, and an act of appropriation. They in no instance omitted this strange practice, however small the article."[10] It is well known that once a Cow, Sheep, or Dog has licked its own little foundling, the feeling of kinship and possession is established. Maybe human kissing had a cognate origin.)

Then the Squirrel ran along the ground in a jerky, erratic way, selecting a place to bury his treasure. Having decided on the spot, always in the open, away from any landmark, he scratched a hole about three inches deep, thrust the nut into the bottom of it, and replaced the earth, packing it down with his front paws until it was levelled. If approached by another Squirrel during the operation, he drove him away. If another Squirrel came near the place two or three minutes afterward, the owner of the treasure still showed fight; but in five or ten minutes, he seemed to lose the sense of ownership, and other Squirrels might run over the place without provoking hostilities. This Squirrel made ten holes during the hour I watched. After that, he seemed to be weary.

---

[9] Quads. Ill., p. 58.

[10] First Journey, 1823, pp. 17–18.

The question arises, How does the Squirrel profit by these "hides"? It seems to me incredible that he should remember each separate place. Rather, I should say, he has a general guidance from memory of locality, and a particular guidance from smell. I never saw a Squirrel dig without finding the buried treasure, though I have often seen him smell without digging.

This is the habit of the Fox-squirrel and his cousins; but not, apparently, of any of the Red-squirrel group.

I suspect too, that the Squirrels have smell-glands that they use to make quite sure of the place by marking it.

Kennicott records another, and a very unusual kind of storage. It was first reported by Smiley Sheperd of Hennepin, Ill., whom Kennicott considered a reliable observer. Sheperd said that he had "repeatedly observed where the Fox-squirrels have carried large numbers of nuts, and deposited them securely in the forks of small trees, their tracks being readily traced in the snow to where the nuts had been recently dug out. This was observed in cold weather, when the snow was deep."[11]

A Black Chapter

There seems little doubt that, under some conditions, the Fox-squirrel, like the Gray, may become a bird-killer. I have before me a very detailed account of the Fox-squirrels that were brought to Saginaw, Mich., in 1907. They were carefully protected in the city; and greatly increased, to the joy of all that were interested. But they also developed carnivorous tastes to such a degree that they threatened to exterminate all the birds in the neighbourhood.

My informant, William B. Mershon, of that city, writes me (Dec. 3, 1919) concerning these: "They are very destructive in a city. They will rob the nests of robins, take out the eggs, and crush the heads of the fledglings. You cannot have pears or apples for that matter; the Squirrels will cut every one of them, and eat the seeds; that is all they eat—the seeds. My golden bantam corn they discovered before I discovered it, and they got nearly every ear. I have trapped them, and taken them out to the Country Club woods, and liberated them; but still they come from the parks and all around; and my place is a regular rendezvous for them.

---

[11] Quads. Ill., pp. 59–60.

"There is a difference in these Squirrels. Some are vagabond, bird-killing, and fruit-destroying far more than others; so if the bad one is trapped and removed, most of the damage will be prevented until another one, like the man-eating Tiger, gets a taste."

These morbid propensities, so far as observed, occur only under abnormal conditions. It is not unlikely that the unnatural craving for bird-blood is a result of improper feeding. It is well known that some semi-domestic animals will eat their own young unless supplied with salt or its equivalent, and with abundance of fresh water. At all events, the bird-killing habit has never been charged against this Squirrel in its natural state.

Den, Nest, and Sanitation

The Fox-squirrel has two distinct types of house. The first is the den in a hollow tree; the door of this should be about 3 inches in diameter. Any more would let in the owl, the Possum, and other enemies; any less would be uncomfortably tight. In old days, he commonly used the deserted hole of the ivory-billed woodpecker or the pileated woodpecker; these were much to his liking and all ready for use. But the extermination of the former, and the growing scarcity of the latter, have forced him to use the one-time house of the flicker and redhead, working hard with his own chisel teeth to enlarge the doorway to satisfactory dimensions. According to Bachman, the Fox-squirrel, failing to find a ready-made home, does not hesitate to make one. For this, with admirable judgment, he selects some tree so hollow that it is a mere shell; and quickly cuts his way through the thin timber wall, to the soft interior punk, in which his den is soon arranged in comfort and safety.[12] This is the permanent residence, the central citadel: and is usually in some patriarchal tree surrounded by a grove of the later generations.

The second type of house is the built nest. Of this there are two styles: First, a rough platform of twigs and sticks, without roof, in some tree fork quite low down—only 20 feet off the ground in some cases; second, an elaborately constructed nest with a central cavity like a crow's nest, but over that, a well-built, weatherproof roof, and at one side a small entrance, which, thanks to the overhanging leaves and bark strips, is virtually supplied with a self-closing door. This last style is always built high up in some tall tree, usually a big pine or hemlock; and at a point where many branches together form an extra secure foundation.

---

[12] Q. N. A., II, p. 131

The experiences of Bachman and Kennicott go to show that the young are invariably brought forth and nursed in the hollow tree. The roofed nests are used by the parents in hot weather; and the slight platforms are temporary structures for sunning places or one-night camps.

Kennicott gives interesting light on these. He says the Fox-squirrels "build nests wherever they stop, even for a day or two; and I have several times observed individuals to appear in a grove of young oaks, build a nest, remain a few days, and then disappear; perhaps to return again in a week, and build other nests."[13]

Some totally different conclusions, however, are offered by H. L. Stoddard, who says: "In the sand dunes of northwestern Indiana particularly, where Fox-squirrels are still fairly abundant, the young, born in early spring at least, are usually brought forth in a very ingenious type of open nest, though hollow trees are common. These nests are round or oval in shape, tightly woven of freshly cut oak or other tough twigs. Inside of this twig shell comes a thick compact wall of large leaves, evidently pressed into shape while damp, making a smooth, tough lining capable of resisting wind, cold, and rain. The nest proper is then made of soft inner bark, shredded leaves and other material.

"The entrance hole is on one end, and is just large enough to admit the owner; the surrounding fibre often nearly closing the opening."[14]

Sanitation. What methods they adopt to keep themselves and their surroundings sanitary, especially while the young are in the nest, have not been recorded. Collateral evidence would imply that, when the nest gets too filthy or overcrawling, the mother moves the brood to a new lodging.

MATING

From all accounts, the Fox-squirrel is exemplary in its mating habits —one male, one female, throughout the mating season; even though a dozen males be seen chasing one female in the courting time. Furthermore, Bachman says "the sexes seem paired for life."[15] To this, he adds the happy and significant sentence, "the same pair, if undisturbed, may be found in a particular vicinity for a number of years."

"In December and January, the season of sexual intercourse, the male chases the female for hours together on the same tree, running up one side and descending on the other, making at the same time a low guttural noise that scarcely bears any resemblance to the barking which they utter on other occasions."[16]

---

[13] Quads. Ill., p. 60.

[14] Journ. Mamm., May, 1920, p. 122.

[15] Q. N. A., I, p. 148.

In Arkansas, Christmas week is the honeymoon of all Fox-squirrels.

As already noted, the home of the pair, which is also the nursery of the young, is normally in the hollow tree citadel.

YOUNG

In Arkansas, the young are produced at any time from the last of January to the beginning of March; later, as one goes farther north—sometimes as late as April. As soon as they come, or probably before, the father gets notice in some sort to clear out, and keep away till further orders.

The young, are, as usual with the group, blind, naked, helpless, undeveloped little pink bags of vital possibilities. It would be hard to say what family even they belonged to, at first—they are so rudimentary and small.

They number 2 to 4; 3 being the usual number, and 5 the highest recorded by Kennicott.[17]

This same talented naturalist says that probably two litters are produced each season;[18] though Bachman seems to think that one brood is usual, except in the Southern States.[19] In all ways, it is a less prolific animal than its cousin, the Gray.

The young are closely confined to the home nest for 4 or 5 weeks, feeding exclusively on mother's milk; for, so far as known, no Squirrel ever brings home food for its young.

Frequently, the mother decides to move them while they are in the helpless early stage. In carrying them, there can be little doubt that she holds the skin of the belly in her teeth, while the little one clutches mother's head and neck with all four paws. This is fully discussed in Herbert Lang's paper.[20]

When about 10 or 12 weeks old, according to the best light available, the young begin to come out of the nest, run about the home tree, sample the various growing things that appeal to their noses, and otherwise manifest their conviction that they are now full-grown Squirrels. In Arkansas, where the young are born in late January or early February, they do not show outside much till May.

How long this happy period of their childhood continues, no one has yet set down in print. There are, however, analogies that lead one to say it may continue a month. That is, the young ones are over three months old, probably, when a new spirit enters into the mother's heart, and gives a new shape to her life. The conviction that she has done her duty and her whole duty, grows strong. The purely parental attitude changes, the mother love wanes, the maternal springs dry up; and in some way that leaves no doubt of her meaning, she gives the brood to understand that, since their tails are big enough to guarantee a safe drop, and their stomachs strong enough for a hickory diet, they had better move out and shift for themselves, using, if they will, one of the numerous family outhouses; but that henceforth they must eschew the great citadel.

---

[16] Q. N. A., II, pp. 135–36.

[17] Quads. Ill., p. 60.

[18] As above.

[19] Q. N. A., II, p. 136.

[20] How Squirrels and Other Rodents Carry Their Young, Journ. Mamm., Feb., 1925, pp. 18–24.

And father, who has been camping in the best available outhouse, sees with joy that the coast is clear once more, and the signal out—no one knows just what it is—that he is not only free to come home, but will be more than welcome now. Sometimes, he has learned the bachelor habit, and declines to come back on any terms; at least until next midwinter, when the mating instinct once more asserts its absolute sovereignty. But, usually, he comes back as soon as the ban is lifted.

The young have no wish to go, but mother knows her mind, and father is ready to act as policeman. So the weanlings unwillingly obey, to hang about the home grove, and lead unmated, solitary lives for the rest of that summer at least.

There is some evidence, however, that in autumn, when the nights turn cold, the young may reassemble at the old family homestead, and put in a sociable winter together, warning each other of danger, foraging together by day, and keeping each other warm at night in the familiar den, where first they saw the light.

"While the females and young are together in early autumn," says Kennicott, "it is amusing to watch the movements of a party on any pleasant day, when their enjoyment of the abundant food, and things in general, is testified by a degree of sprightliness and agility quite astonishing."[21]

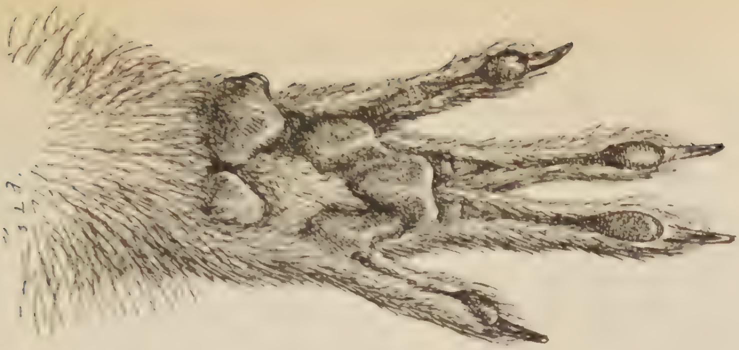
In January, no doubt, if not sooner, this good fellowship is broken up; for not only are the old folks preparing for the brood that is to be, but the young themselves are scattered by the inevitable urge to seek each a mate, and start a little home ranch of his own.

Ground Habits

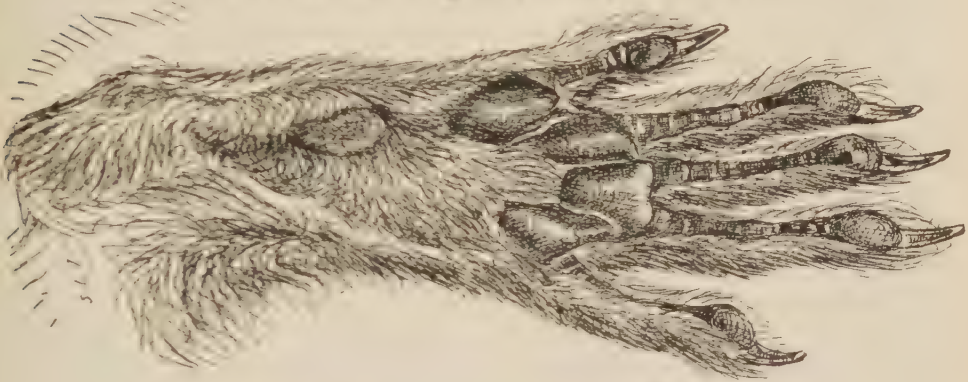
Of all the true Squirrels in eastern America, the Gray-squirrel shows the highest development of the tree-dwelling habit. In comparison, the Fox-squirrel does not stand well—is, indeed, much more of a ground animal.

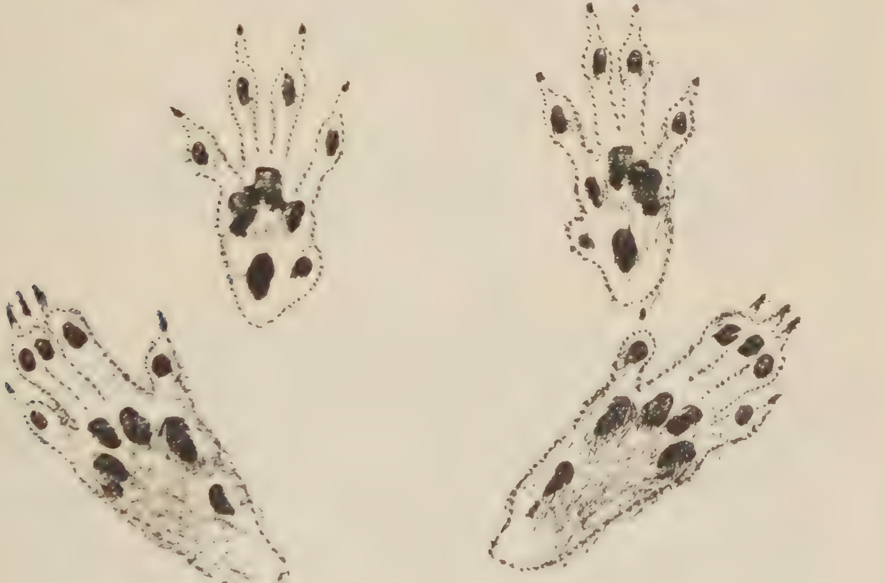
---

[21] Quads. Ill., p. 61.



Foxsquirrel ♀, from Missouri
15 Feb. 1907, Actual length of hind foot - 2$\frac{7}{8}$ inches.





Black-tracks of Foxsquirrel, - with outline of foot indicated

PLATE VII.—DETAILS OF FOX-SQUIRREL

The southern Fox-squirrel (*niger*), says Bangs, is "wholly confined to the great pine forest of the South Atlantic and Gulf States; breeding in trees, often building its nest in the little cypress ponds so common in this region, living principally on the ground, and climbing trees, even when pursued, with apparent reluctance, and in a heavy and clumsy manner.

"Its usual way of escape when chased, is to run along the ground to some stump or log, upon which it climbs, and waits until its pursuer comes too near, when it runs to another place of vantage, and so on. It takes to a tree only as a last resort, and then keeps to the trunk and large branches, trying to avoid detection by hiding. I believe it never jumps from tree to tree, as does its more agile and lightly built cousin, the Gray-squirrel."[22]

In April, 1902, I released 6 Gray- and 3 Fox-squirrels in my woods. The Gray-squirrels made at once for the nearest tree, sprang behind, then up its trunk. The Fox-squirrels each bounded on the ground for 20 or 30 yards past many trees, before selecting one to climb.

"When, however, he is on a small tree," remarks Bachman, "and is made aware of being observed, he utters a few querulous barking notes, and immediately leaps to the ground, and hastens to a more secure retreat."[23]

It runs much better upon the ground than the Gray-squirrel; and, consequently, often ventures far from its home, sallying out on occasions a mile or two across the open prairie. "Several instances are on record," says Kennicott, "of a Fox-squirrel crossing a prairie in summer, 4 or 5 miles in width, to reach timber upon the other side."[24]

When surprised in the open, it will run a long way upon the ground towards its home tree, passing many others; even though that home tree be, as Bachman says, "a quarter of a mile distant; and it requires a good Dog, a man on horseback, or a very swift runner, to induce him to alter his course, or compel him to ascend any other tree."[25]

Shy and Retiring

This Squirrel is much less gregarious than the Gray-squirrel; and sociable only in a slight degree. In most cases, the pair live by and to themselves; and oftentimes an old one, usually a male, is found leading a quite solitary life.

In the great overland treks of the Gray-squirrel, the Fox-squirrel apparently took no part; although adventurous individuals do occasionally make long journeys in search of food.

---

[22] Squirrels, p. 147.

[23] Q. N. A., II, p. 137.

[24] Quads. Ill., p. 62.

[25] Q. N. A., II, p. 137.

The Fox-squirrel is extremely shy and retiring. Kennicott remarks that it is more shy in the woods than any others that he had observed; "yet it takes up its abode near dwellings much oftener than the others; indeed I know of no Squirrel, excepting perhaps the Chickaree, that will live as near the habitations of man as this. I have observed several instances in which pairs of Fox-squirrels have lived and reared young, for a number of years, in trees situated within a few rods of dwelling houses; and, in winter, I have seen these, as well as others from the woods, come boldly about the farm-yard or corn-crib in search of food."[26]

AMUSEMENTS

Since it is so little inclined to sociability, we should not expect the animal to have social amusements. Yet it has, apparently, one established game—a sort of over-the-tree-top tag. Kennicott's account of it is that of a man who saw it with his own eyes. He was concealed under a hickory tree one afternoon, in September, while 4 or 5 Fox-squirrels disported themselves above. "They seldom remained quiet for a minute at a time. If not eating, they would scamper up and down, sometimes springing from limb to limb, with no other apparent object than fun. Their long bushy tails were never kept still, but continually jerked up and down. Occasionally, one would stop for an instant, and utter a short bark, or chatter. One kept aloof from the rest, and when approached by any of them in their play, chased them off with an angry guttural snarl."[27]

No doubt, this one was a grouch. He didn't want to play; or someone had done him wrong, and he was sulking—much as we see in our own play games.

A SQUIRREL HUNT

My first close acquaintance with this child of the oak openings, was on Nov. 6, 1920, on the Colorado River, some 20 miles southeast of Austin, Tex. On that dull and drizzly day, I set out with Judge George Mendell, Chief Game Warden J. R. Jefferson, and young Jefferson, to see a noble forest of primeval trees, where still the Fox-squirrel was to be found in numbers.

The Squirrel bush was chiefly of oaks, pecans, and red elms, scattered over the gently undulating ground like a park. It was about 100 acres in extent; and the Game Warden said that it probably contained 500 Fox-squirrels. Yet not one did we see by stumbling on it. The Dog racing about, presently gave tongue up a big red elm. We then began the usual method of locating the Squirrel. Two men with guns remained still and on watch at different points. The other two walked noisily around the tree at a radius of 50 or 100 feet. This caused the Squirrel to sidle around the limb against which he was flat and hiding. Many escaped notice altogether by quietly slipping behind a big limb as we approached.

---

[26] Quads. Ill., p. 62.

[27] As above, p. 61.

At the first tree, the Squirrel evidently got into a hollow limb, for we saw him not. The second, the Judge brought down from a height of 75 feet. The third was in his nest, and died there, as the Judge emptied two shots into it. This nest I sketched.

The Dog evidently treed 6 or 7 Squirrels, that is, tracked them to trees; but we got only 4.

Proud and Lazy

The Fox-squirrel is, in some respects, the highest product of evolution in the Squirrel family. It is our largest, most specialized, most variably coloured Squirrel. But in some matters, it is far behind the time; and so badly equipped for the life-struggle that we do not wonder at its disappearance from a large part of its range.

Bachman, with the Gray-squirrel in mind as a standard, says that the Fox-squirrel "is the most inactive of all our known species";[28] and most hunters who know both, consider the Fox a very fat, logy beast beside the slim and active Gray.

Kennicott, however, had a much higher opinion of its gifts. He applauds its activity and its vigilance.[29]

On one point all observers are agreed—its courage. When overtaken on the ground by a Dog, Bachman says it will defend itself "with great spirit; and is often an overmatch for the small terriers which are used for the purpose of treeing him."[30] A 2-pound Squirrel all alone—a 15-pound Dog with men and guns to back him. Think of it!

Once the Fox-squirrel reaches the home tree, it makes no defiant speech from the limbs, as the Gray- and Red-squirrel often do; but, in a twinkling, disappears into the hole. Indeed, at all times, it is more ready to hole up than are its Red and Gray kinsmen.

Not only is it brave and combative, it is also very tenacious of life

---

[28] Q. N. A., I, p. 147.

[29] Quads. Ill., p. 61.

[30] Q. N. A., II, p. 137.

Ordinary shotguns, unless at short range, seldom bring it down. The old Squirrel hunters of Kentucky always used the rifle for this game. It is a pity that we did not adhere to their code; for the coming of the high-power shotgun robbed us of both our sharp-shooters and our Squirrels.

His Time o' Day

It has been seen that the Gray-squirrel is astir at dawn, and again in the evening, with a daytime interval of rest. The Fox-squirrel does just the reverse. He rouses his duller mind, and stretches his fat form, only when the sun is strong on the tree-tops. On sunny days, early or late, he commonly sprawls happily in one of the built nests, enjoying the sun and the world generally, but out of sight of gunners and other ground marauders.

Ten or eleven in the morning is the favourite time with him. Forth he comes in that hot, bright spell; and, for four or five hours, prowls and plays the life game with the fullest measure of his gifts. Then, as definitely, he retires to rest, as though he meant to avoid meeting that Gray-squirrel crowd, with their vulgar levity and unrestraint.

Of the two, the Fox-squirrel seems inferior so far as concerns equipment for the modern life-struggle. Twenty-five years ago, I stocked my Connecticut woods with both species. The Fox-squirrel disappeared the first season; the Grays are there yet.

Arctic travellers and Sahara travellers all seem agreed as to this: one can stand any amount of climate as long as there is no wind. This is precisely the view of the Fox-squirrel. He does not mind heat or cold or rain, but he does hate wind. He will come out in zero weather—as I have witnessed in Illinois—or he will frolic in the rain, with just a little less spirit than in the bright, actinic days of autumn. But a high wind is a finisher to Squirrel joy—it spoils his balance and his jumps; it makes his limb roads wavy and insecure. It affects him just as it does the birds; that is, it is the most exasperating and repressive weather condition he has to meet.

To know the Fox-squirrel in his glory, one must see him in the bracing days of early autumn in a nut year, when the magic of a low red sun is on the woods. He is bent chiefly on forage, and gives little time to games or music. There may be a dozen of his fox-red fellows in the grove; but they make much less noise than two or three of the Grays.

Each fat Redtail has a special perch or eating stool on which he takes practically his whole meal. Running out far on the most slender twigs, he grabs a nut, cuts it loose; then, going back to his stool, he quickly chisels it open, drops the shells, eats the kernel, and goes to the far twigs for another, and another—until his hunger is ended. If, as sometimes happens, he drops the nut after cutting it loose, he gazes after it with a worried expression that seems to say, "That was probably the finest nut in the tree, and now it's gone to the demnition Chipmunks."

He may have gleaned over a radius of 25 feet for his catch; but all the rejected nuts and shells are directly under the table and work-bench he had selected. At such times, he is much preoccupied and silent.

Guided by the rattling down of the shells, one may approach with caution. But the moment an intruder is sensed, he gives the barking alarm cry; and either flattens himself against some protecting branch, or bounds away—as often on the ground as along the overhead limbs—till he reaches home or some other oft-proven citadel of safety.

Like the Gray-squirrel and Cottontail, not to speak of Woodchuck and Chipmunk, the Fox-squirrel seems to be gifted with some power of hibernating. That is, provided he is fat and well, and the weather very cold, he can continue for many days without eating, in a sort of "cold sleep." This is not true torpidity, as he is quite conscious, and ready to resume active life, as soon as it is worth while; which is another way of saying, as soon as the food supply is normalized, and the high cost of living is reduced. As a contrast, I noted a Fox-squirrel in Champaign, Ill., some years ago, who was perched on the top of a tall tree in the coldest spell of the winter, quite content, apparently, to consider a man-provided stock of chestnuts as more than an offset for zero weather.

Use of the Banner Tail

The tail, in the Squirrel family, has been developed as a parachute, a land-easy. It is fitting, then, that it find a high development in this highly arboreal species.

It is functional in other ways also. It serves as an umbrella, a signal flag, and as a shield in battle.

James N. Baskett, writing of a mischievous pet Fox-squirrel, says: "Once I impatiently hurled a magazine at him, which struck the wall just above him. It scared him nearly to death. He could not realize what had happened.

"He sprang away, but began to approach the region again shortly, to investigate it. As he went by it on one side, he held his tail between the danger spot and his body; as he went back, he held it on the other side. Finally, he approached it end-on, smelling at it; but he extended his tail entirely over

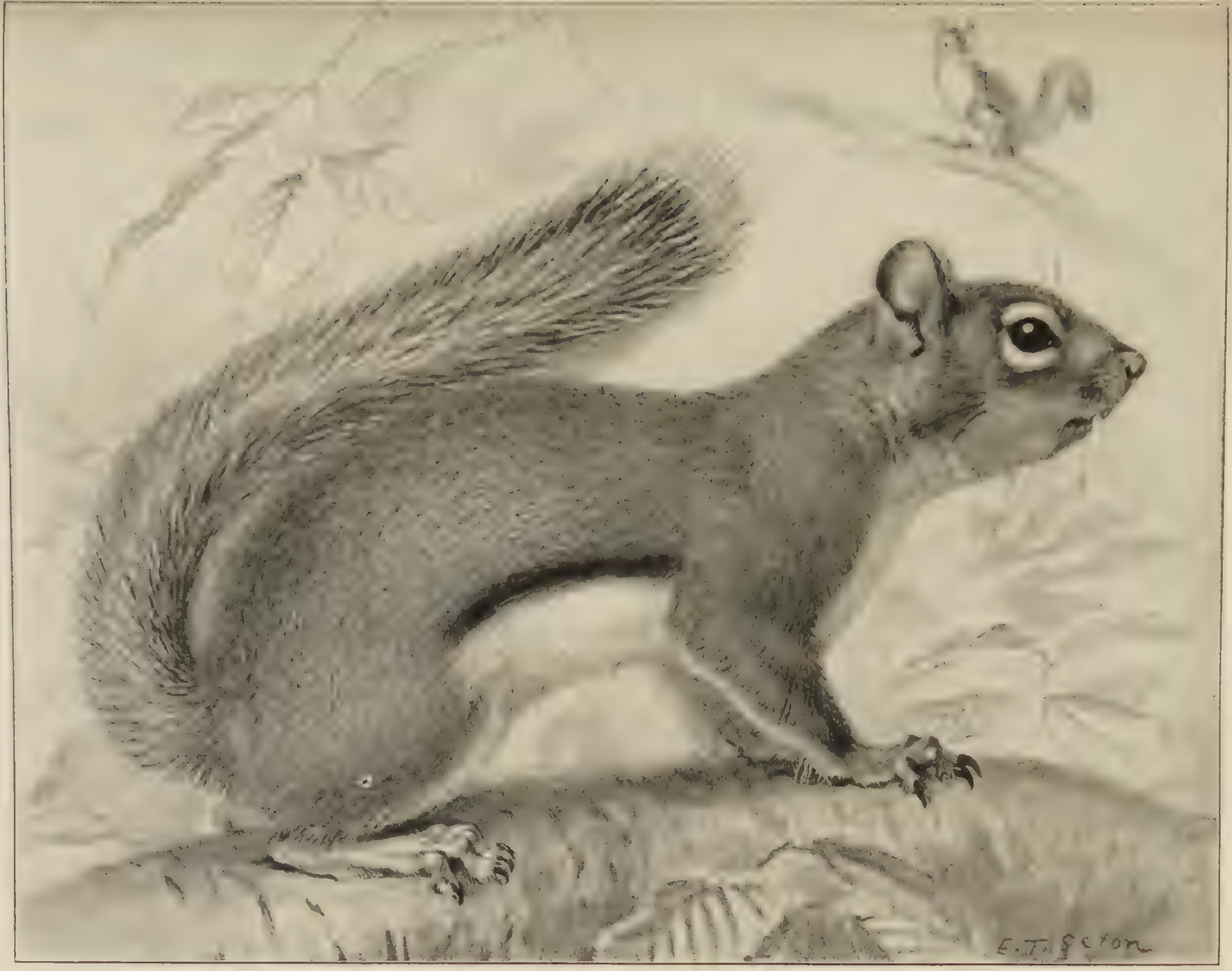


PLATE VIII. RED-SQUIRREL (ABOUT $\frac{3}{4}$ LIFE SIZE)

(*Sciurus hudsonicus* Erxl.)
Connecticut, 1906

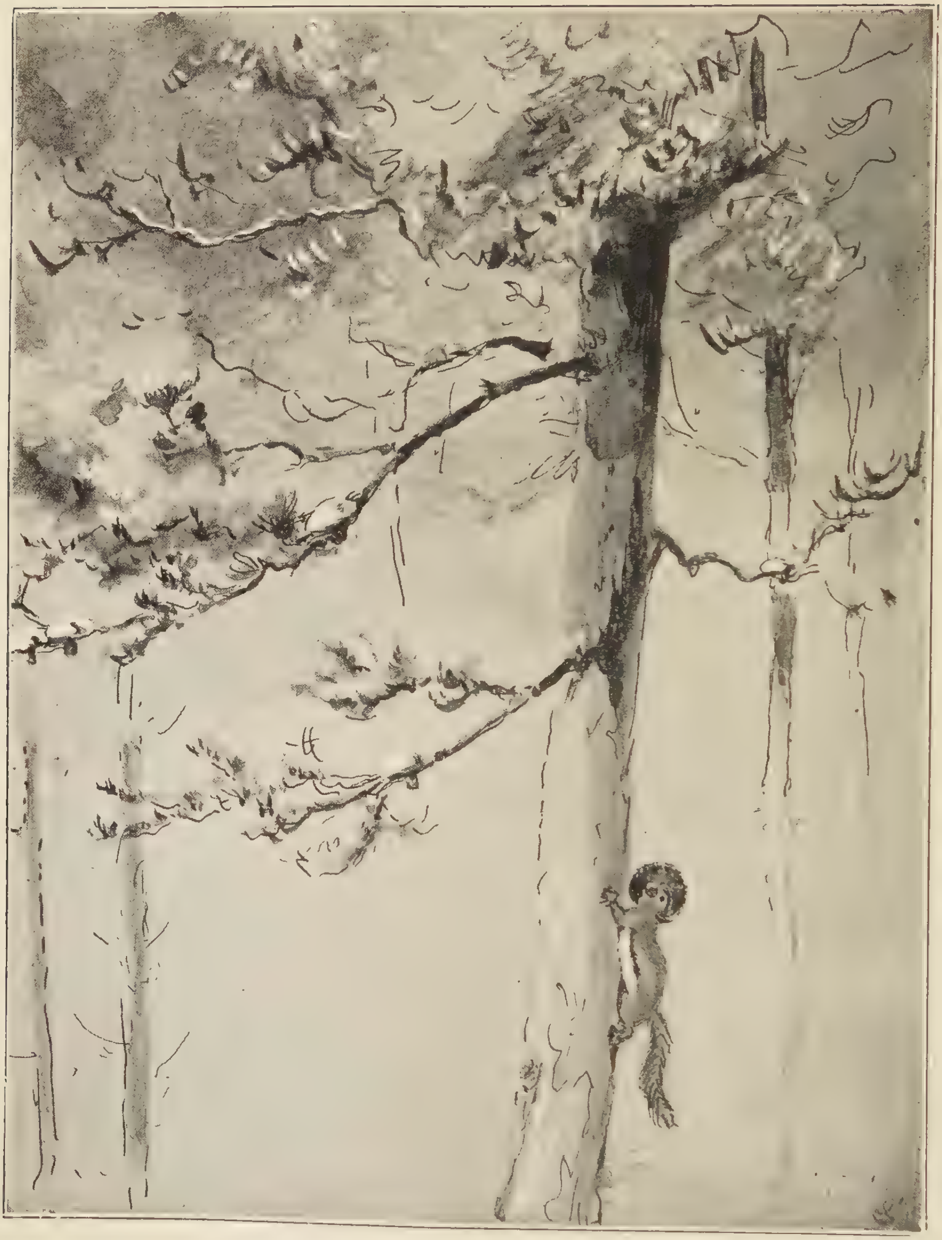


PLATE X.—RED-SQUIRREL STORING UP MUSHROOMS

Rocky Mts., B. C., Aug., 1899. By E. T. Seton his body, and felt with its hair tips the suspicious place where the missile struck, springing back from it occasionally in fear.

"When on a limb, a Squirrel sits with his tail curled so beautifully over his back, he hoists it in the hope that if a hawk or an eagle swoops, it may grasp that member and leave his body free."[31]

VOICE

This species is usually more silent than the Gray-squirrel; and, if one of them hears any loud noise in the woods, it hides or runs to its hole, instead of chattering or barking at it, as both Gray- and Red-squirrel often will.

Kennicott thus describes the actions of one that he had watched for some time before it discovered his presence. Then "he first uttered several abrupt notes, *quak-quak*, and then a long, shrill *qua-a-a-a*, the number of the short sounds varying, but always followed by the long sharp *qua-a-a*. At the repetition of each short note, he jerked his body violently, and whisked up his tail slightly, giving it a gracefully undulating motion. He continued to bark thus incessantly for several minutes, until at length, I exposed myself fully to view, when he hastened to the opposite side of the tree, and ran to the top, uttering a low chatter of affright."[32]

They have a low snarl of anger that is used chiefly among themselves; and, last, a love song. This love song is much like that of the Gray-squirrel; but is hoarser and more guttural, and has little or none of the long, final note. It sounds like *quak-quak-quaaaaaaa*, with many repetitions and a few variations, uttered from some commanding perch, for an hour or more at a time when the weather is inspiring, or the love-fire setting all his frame aglow.

HIS ENEMIES

What are the enemies of this most distinguished Squirrel? Who are the evil ones, that have so far prevailed, that the stars now war against him? —for his palmy days are done.

The Fox, the Wild-cat, or the Weasels, never took large toll of this Squirrel's kind, for they do not love the times or places where he is most at home. The hawks are unimportant; and, according to Bachman, the owls do not count at all,[33] for the Squirrel keeps as closely to the hours of sunlight as the owls do to those of night.

Of insects, the *cuterebra*, or bot-fly seems most to annoy the Squirrels by laying its eggs so that its grub develops under their skins. But so far as I can see from the analogy of Ground-squirrels, this does no harm beyond the temporary drain. The subject is fully discussed in the *Gray-squirrel* Life (p. 54). Mosquitoes, the terror of big mammals in many regions, seem to let the Fox-squirrel alone.

---

[31] St. Louis Republic, quoted in Literary Digest, Feb. 14, 1914, p. 333.

[32] Quads. Ill., p. 61.

[33] Q. N. A., II, p. 137.

In their rivalry for the abandoned holes of woodpeckers, several otherwise neutral species may be reckoned enemies. The most curious case is that detailed by Bachman. He says:

"The summer duck (*Anas sponsa*), too, is frequently a competitor for the same residence; contests for possession occasionally take place between these three species [woodpecker, Squirrel, and duck]; and we have generally observed that the tenant that has already deposited its eggs or young in such situations is seldom ejected. The male and female summer duck unite in chasing and beating with their wings any Squirrel that may approach their nests, nor are they idle with their bills and tongues, but continue biting, hissing, and clapping their wings until the intruder is expelled. On the other hand, when the Squirrel has its young in the hole of a tree, and is intruded on, either by a woodpecker or a summer duck, it immediately rushes to its hole; and, after having entered, remains at the mouth of it, occasionally protruding its head; and with a low, angry bark, keeps possession, until the intruder, weary of the contest, leaves it unmolested."[34]

A quaint story of an ancient rivalry is furnished by L. F. Hunt, an Iowa old-timer. "One day [some 30 years ago]," he says, "while out Squirrel-hunting, I saw a Fox-squirrel run up a tree that I knew contained bees. He ran out on a limb and made the longest jump I think I ever saw a Squirrel make, but he hit an old hollow dead tree that the top had been broken off, and he went in at the top and down in the tree. I could hear him chatter and scratch and the bees seemed to be getting the best of him. So, after watching a while, and he did not come out, I went on home."[35]

I can find no record of the Red-squirrels persecuting the present species, as they certainly do the Gray-squirrel.

The last, largest, and lethal enemy of this, as of all our harmless wild life, is man with his atrocious firearms. As long as the rifle only was used, the Squirrels could live and prosper—yes, and render us the great service of training a standing army of matchless sharp-shooters. But when the rifle was laid aside, and the shotgun, reinforced with the axe, came in, the Squirrels could not face the new slaughter—their doom was spoken. Already, half of their ancient range is desolated; and in the territory still held by them, their numbers are so low, that we can hardly reckon the Fox-squirrel among our standard game.

---

[34] Q. N. A., II, p. 135.

[35] Hunter-Trader-Trapper, Nov., 1924, p. 53.

HIS CLAIM TO PROTECTION

In flesh and flavour, this species is scarcely to be distinguished from the Gray-squirrel. Bachman mentions, however, that the Gray is usually preferred as more tender and delicate, though both are apt to pall if used very long as a staple of diet.[36]

It is easily domesticated, and occasionally seen in cages; but is less sprightly and entertaining than the Gray-squirrel. As a pet, the Fox-squirrel seems gentler and safer than the Gray. I have seen two or three that were ideally tame and kind.

P. A. Taverner, of Ottawa, tells me that he knew the Fox-squirrel very well during his years of residence in Michigan; and considers it far more easily tamed, and much more intelligent than the Gray. Late one winter, about 1912, at Ann Arbor, Mich., he saw an amusing sight that illustrates the disposition of the Fox-squirrel. Near the campus of the University, was a little girl sitting in the porch of her home; she was feeding a lot of Fox-squirrels. Nine were scrambling all over her at once, as she cracked walnuts and hickory nuts with a hammer to feed them. She could scarcely keep from cracking their heads, they crowded in so closely, and were so eager to seize every nut as soon as it was available. Those that could not get on her lap, went through her pockets.

William B. Mershon, telling of the Fox-squirrels that his daughter had trained to come to her window for peanuts, writes me (Dec. 3, 1919): "She was away some days. The bag of peanuts was somewhere in her room; and the Squirrels, finding the window open and the screen closed, gnawed or cut a hole in the copper wire netting, went in, and found the peanuts—and nearly everything else. When my daughter returned and went to her room, it was in horrible disorder. Vases had been knocked over, nearly everything upset in the way of photographs and bric-à-brac. In her knitting and sewing bags, the Squirrels had mixed up everything. Peanut shells were all over the floor. Evidently the weather had been wet, and the ground muddy, for Squirrel tracks were everywhere. While she was looking over the ruins, the marauders appeared, and came through the hole to greet her. They saucily sat up on the table and shelf—four or five of them, the whole family, no doubt. They jabbered and chattered as much as to say they were glad she was back to get a new bag of peanuts, for the old supply had been exhausted."

---

[36] Q. N. A., II, p. 137.

Age

I have but two notes that show the age that the species may attain. Dr. J. M. Downie, of San Antonio, Tex., raised one from the nest. At 9 years of age, it passed away quietly in its sleeping box. Evidently, it had lived the full term of its kind.

At Fort Orange, near Ormond, Fla., Feb. 17, 1914, Mrs. F. A. Roe, the authoress, showed me a picture of a white-nosed Black-squirrel that she had had as a pet. It was taken from a nest of 5. Two of the others were black and 2 were brownish black. It showed signs of extreme age when it died, at the age of 10 years.

References

1849—Quadrupeds of North America, II, by Audubon and Bachman, pp. 132–38.
1857—Quadrupeds of Illinois, by Robert Kennicott, pp. 55–62.
1877—Monographs of North American Rodentia, by Elliott Coues and J. A. Allen; Fox-squirrel by Allen, pp. 718–31.
1896—Review of the Squirrels of Eastern North America, by Outram Bangs, Proc. Biol. Soc. Wash., Dec. 28, pp. 147–53.
1909—Notes on the Distribution of Certain Mammals in the Southeastern United States, by Arthur H. Howell, Proc. Biol. Soc. Wash., April 17, pp. 58–59.
1919—Notes on the Fox-squirrels of Southeastern United States, by Arthur H. Howell, Journ. Mamm., Nov., pp. 36–38.

LIFE LXVI—APACHE SQUIRREL

PAGE
Names 108
Description: Size, Colour 108
Range 108
Nest and Young 108
Food and Habits 109

Apache Squirrel, Apache Fox-squirrel, Banded-back Squirrel

Sciurus apache Allen

(L. *Sciurus*, see *ante; apache*, because found in the Apache country)

Sciurus apache ALLEN, 1893, Bull. Am. Mus. Nat. Hist., V, p. 29, Mar. 16.

TYPE LOCALITY—Mountains of northwestern Chihuahua, Mex.

When seen in the trees, this fine animal is indistinguishable from its near relative, the Fox-squirrel; except, of course, in view of the region where seen.

From *aberti*, it is easily distinguished by the absence of ear-tufts, and the absence of white on the tail; from *arizonensis*, by the yellow underparts.

In winter, the black band down the back is an important mark.

To the generic characters, it adds the following:

Size. Head and body, 21¾ in. (554 mm.); tail, 11¾ in. (298 mm.); hind foot, 3 in. (76 mm.).

Colour. In summer, all above, pepper-and-salt gray, tinged with yellow; cheeks, feet, and all below, buff; tail, yellow, with black band all around, narrow at sides, broad at tip; tip of tail, yellowish white.

In winter, it has a broad black band down the back from crown to tail.

This Squirrel is much like the Fox-squirrel, not only in dentition; but also in appearance during summer, when the black band is absent.

RANGE

It ranges in the mixed oak and pine forests of the Transition region from 5,000 to 7,000 feet above sea, on the central plateau of northern Mexico and southern Arizona. So far, it has been recorded only from Chihuahua Mountains on the United States side, as herein noted. It is a very rare species. See Map II, p. 85.

NEST AND YOUNG

All nests noted by Mearns were in the oaks that it chiefly feeds in. A female shot in Turkey Canyon, San Luis Mountains, Chihuahua, Mex., July 11, 1892, contained 3 young, very near the time of birth.

Food and Habits

Its favourite food appeared to be the acorns of *Quercus hypoleuca*.

Its habits, according to Mearns, are much like those of its near kinsman, the Eastern Fox-squirrel.[1]

---

[1] Mammals of the Mexican Boundary, 1907, p. 272.

LIFE XLVII—ARIZONA GRAY SQUIRREL

PAGE
Names 112
Description: Size, Colour 112
Races 112
Range and Migration 112
His Canyon Life 113

Arizona Gray-squirrel, Canyon Gray-squirrel, Canyon Fox-squirrel

Sciurus arizonensis Coues

(L. *Sciurus*, see *ante; arizonensis*, of Arizona)

Sciurus arizonensis Coues, 1867, Amer. Nat., I, p. 357.

Type Locality—Fort Whipple, Yavapai Co., Ariz.

When seen in its native surroundings, it is, at first glimpse, a large Gray-squirrel with a long, dark tail and no ear-tufts; from *apache*, it is distinguishable by the reddish band down the back, and the white underparts.

To the generic characters, it adds the following:

Size. Head and body, 20½ in. (520 mm.); tail, 10⅜ in. (262 mm.); hind foot, 2¾ in. (70 mm.).

Colour. All above, pepper-and-salt gray, with a broad, rusty band from back of head to tail; underparts white. Tail above, black, sprinkled with white in the middle; below, rusty brown, with a broad, black band and a white edging. In summer, the pelage is practically the same, except that the rusty band is absent from the back.

Races

Two races have been recognized:

arizonensis Coues, the typical form. T. l., Fort Whipple, Ariz.

huachuca Allen, smaller, without the rusty band on neck and shoulders. T. l., Huachuca Mts., Ariz.

Range and Migration

This species does not range so high as the Tasselear; it prefers the deciduous forests along the streams and canyons. Its interests might clash with those of the Apache Squirrel, but that their territories do not overlap, so far as known.

Dr. E. A. Mearns, on whom I have drawn for most of the Arizona information concerning Squirrel habits, says that the present, "in common with other Squirrels, sometimes migrates from place to place in large numbers. Mr. Stewart Daniels, who obtained many specimens of mammals and birds for me in Arizona, resided for several years in the canyon of Fossil Creek, 25 miles southeast of Fort Verde, without seeing one of these Squirrels; but during March and April, 1886, there was a sudden influx of them, and numbers were seen daily. I am indebted to Mr. Daniels for 8 specimens which he kindly sent me at the time."[1]

His Canyon Life

Dr. Mearns thus describes his first meeting with this Squirrel. After a long tramp, he was resting on the porch of a miners' cabin at the head of Weber Creek, July 29, 1887. He was enjoying the idyllic scene of babbling brook among stately trees, when his "eye caught some falling chips of pine cones, dropped from a pine top by a Squirrel, which," he says, "I immediately recognized as this species, by its long dark-coloured tail. With inimitable grace, it would make its way to the very extremity of a branch, select and remove a cone, and then return to a branch beside the tree trunk, to extract the seeds at its leisure. On investigation, I found this species quite abundant along the creek, and, for the purpose of making its identification absolute, shot one. The specimen proved to be a young male of the year, already two-thirds grown.

"About a fortnight later, I returned to Weber Creek with a shotgun, obtained 6 specimens, all of which were shot in the pines. They were very shy and difficult to discover. It was only found in the vicinity of the streams, where it was less abundant than the Abert Squirrel; several were seen running on the ground, searching for something among the heaps of débris and brushwood. Its habits and actions closely resemble those of the Eastern Gray-squirrel."[2]

Discussing the food of the other race, *huachuca*, Mearns says its food comprises seeds of pines, acorns, walnuts, berries, and green vegetation. It is extremely fond of walnuts, and commonly eats them in July and August when the husk is green, and full of dye-juice; so that the Squirrels are often stained beyond recognition. Especially does the white hair of the underparts take the rusty colour, so that some naturalists have been puzzled by what seemed a new colour variation. But Dr. Mearns points out first, that the palms and soles of the feet show plainly when it is stain, and those mothers that are nursing have clear white fur around the teats, where the babies keep it clean.[3]

---

[1] Mamm. Mex. Bd., 1907, p. 275.

[2] As above, p. 276.

[3] As above, pp. 279–80.

This stain is found only during the walnut season, and in the walnut groves.

Mearns found a nest of this species. It was "built in an ash tree, and closely resembled the summer nest of the Eastern Gray-squirrel."[4] The place was among groves of mulberry, ash, and walnut trees—and, as usual, by a sparkling stream; for this Squirrel, more than any other, seems partial to running water, and not happy if far from it.

---

[4] Mamm. Mex. Bd., p. 276.

and sometimes

LIFE LXVIII—RED-SQUIRREL

PAGE
Names . . . 117
Description: Size, Weight, Colour . . . 117
Races . . . 118
Numbers and Migration . . . 119
Squirrels in the Water . . . 120
Range and Haunts . . . 121
Home Range . . . 121
The Expressive Tail . . . 122
Foes—in Fur and Feathers . . . 123
Enemies in the Water . . . 125
Parasites . . . 126
Food Staples . . . 128
The Workshop . . . 128
Mushroom Diet . . . 130
Bark and Sap as Food . . . 132
Fruit-eater . . . 133
Odds and Ends . . . 133
Storage Habit . . . 133
The Red Robber . . . 134
The Desecration of the Sanctuary . . . 135
The Defence . . . 135
Nests . . . 136
An Uncivilized Little Beast . . . 137
Marriage Customs . . . 138
The Coming of the Young . . . 139
A Coming-out Party . . . 141
A Nocturnal Merry-maker . . . 142
Powers . . . 143
His Wildwood Song . . . 143
Sociability and Games . . . 144
Odd Happenings . . . 146
Age . . . 147
His Way of Life . . . 147

PAGE
In Zero Weather 148
Tunnels in the Snow 148
Redcoat's Value 148

References 149

Common Red-squirrel, Chickaree, Pine Squirrel, Rusty Squirrel, Adjidaumo, Puck-o'-the-Pines, Red Robber, Egg-eater, Chatterbox

Sciurus hudsonicus Erxleben

(L. *Sciurus*, see *ante*; *hudsonicus*, because it was first described from Hudson Bay)

[*Sciurus vulgaris*]*hudsonicus* ERXLEBEN, 1777, Syst. Reg. An., I, p. 416.
Sciurus hudsonicus ALLEN, 1894, Bull. Am. Mus. Nat. Hist., VI, p. 325, Nov. 7.

TYPE LOCALITY—York Factory, Hudson Bay

FRENCH CANADIAN, *l'Écureil roux, ou de la Baie d'Hudson.*
OJIBWAY, SAUTEAUX, MUSKEGO, and CREE, *Ad-jee-dah-mó*, said by Animeekong to mean "head downwards," which is another way of saying "tail in air."
CHIPEWYAN, *Kleé-ay.*
YANKTON SIOUX, *Kee-hah-chah.*
OGALLALA SIOUX, *Zee-cha.*

In any part of its region, or in any of its coats, it is known at once as a red Squirrel, with a white breast.

Its nearest relatives are:

The Douglas Squirrel (*S. douglasii* Bachman) which is readily distinguished by its orange or buff underparts.

The Fremont Squirrel (*S. fremonti* Audubon & Bachman) which is characterized by white-edged tail, a yellowish rufous backband, gray upper parts, and white breast speckled with gray.

These are so nearly related that Preble thinks that complete intergradation of the three may yet be proven.

In addition to the generic characters, the Red-squirrel has:

Size. Length, about 12 in. (305 mm.); tail, 5 in. (127 mm.); hind foot, $1\frac{7}{8}$ in. (48 mm.). In Manitoba, Carberry specimens are largest; Lake of the Woods, smallest.

Weight. $8\frac{1}{2}$ to 9 oz. (*Murie*).

Colour. In summer, the typical Red-squirrel is a sort of olive pepper-and-salt above, becoming redder on the legs, feet, tail, and ears; and darker and more olive on the head between the eyes; pure white on the lips, chin, throat, ring around eye, underparts of body, and inner parts of limbs; with a black stripe extending along the side of the body between the dark upper colour and the white below. Near the end of the tail is a broad tapering band of black, and the tail is finished with a border of yellowish or grayish colour.

In winter, it loses the black stripe along each side, but adds a broad red band down the back and tail, and a speckling of dark gray over the white below.

Sexes alike.

Albinos are not rare. The following interesting note was given me by Capt. George Eisenhard, of Culver School, Indiana. In 1916, a white-tailed, *i. e.*, part albino, Red-squirrel, lived in a big oak by the mess hall in Culver. She mated with an ordinary Red-squirrel. In August, the young—4 or 5—were seen running with the mother. All had white tails—which seemed to prove their ruin; for the Cats killed them, one by one. The last, when nearly full grown, was caught in September by a cunning House-cat. "We looked on as she made a rush of 20 feet, and seized the Squirrel on the ground. Its white tail made it very conspicuous."

A single melano or black Red-squirrel is recorded by J. A. Allen in his *Revision*, p. 273. It is from Nulato, Alaska.

RACES

The following races are recognized:

- *hudsonicus* Erxleben, the typical form. T. l., York Factory, Hudson Bay.
- *gymnicus* Bangs, smallest of all the races; hind foot small; colour dark, tail dark with red or orange fringe; breast, peppered gray in winter. T. l., Greenville, Me.
- *loquax* Bangs, a large form, very red above, and always pure white below. T. l., Liberty Hill, Conn.
- *minnesota* Allen, a pale form; largest of all; hind foot large; most obviously differing from *hudsonicus* in having under-side of tail all gray instead of rusty red. T. l., Fort Snelling, Minn.
- *dakotensis* Allen, a large and very pale form, quite the palest of all, and white below. T. l., Squaw Creek, Black Hills, S. D.

baileyi Allen, very large, more olive, and darker above than the type; washed with fulvous below. T. l., Bighorn Mts., Wyo.

ventorum Allen, a large form like the foregoing, but darker, more olive, and grayer below. T. l., South Pass City, Wyo.

richardsoni Bachman, a large form, still darker than *ventorum;* with much black, especially on the tail, which is nearly all black above. T. l., Head of Big Lost River, Ida.

streatori Allen, a large form much like *richardsoni*, but more olivaceous above in summer; and with a very short tail, of which only the last third is black. T. l., Ducks, B. C.

vancouverensis Allen, like *streatori*, but much smaller, and tinged brownish below. T. l., Duncan Station, Vancouver Id.

petulans Osgood, like *vancouverensis*, but paler. T. l., Glacier, White Pass, Alaska.

picatus Swarth, cranially like *petulans;* in colour, like *vancouverensis*, but brighter. T. l., Kupreanof Id., Alaska.

Numbers and Migration

This species is never seen in vast numbers like the Gray-squirrel of the East.

When the authorities of Bronx Park, N. Y., decided to thin out the Red-squirrels, for the sake of the song-birds and the Gray-squirrels, they killed 60 of them in the 200 acres of woodland, leaving about a dozen. The woods had been well stocked with Red-squirrels, from which we may infer that a Squirrel to every 3 acres is abundance.

I found it more numerous at Kenora than anywhere else in the country, and there I doubt if they would average 1 Squirrel to every 3 acres of pinewoods. In the western part of Manitoba, it is much less plentiful. Possibly 4 pairs of Red-squirrels to every square mile of the country is the highest average we can allow.

Nevertheless, we have evidence of vastly greater concentration in certain alluring places. As we shall see later, Dr. R. G. Waugh, of Carberry, Man., killed 14 Red-squirrels in his acre of bird sanctuary.

Dr. M. C. Rumball, of Morden, Man., tells me that in the summer of 1912, the Red-squirrels in his town became so numerous and destructive to bird nests, that he shot 15 on his house lot, which was 200 by 125 feet. It was well wooded, like the rest of the town. This killing made no visible difference in the numbers of Red-squirrels.

The town spreads over a hundred acres; therefore, must have harboured hundreds of Red-squirrels.

I see no difference in the numbers between ancient and recent times. It seems as numerous now as 40 years ago—no more and no less so.

There is, of course, an apparent great increase always in the fall, as elsewhere noted. Yet I have little faith in the migration of these Squirrels. In autumn, the young are full grown; all the Squirrel population is bustling about, preparing for the winter. They seem so much more numerous than in summer that one often hears the remark that "the Squirrels have come." But among Red-squirrels, at least, it is not in any sense due to a regular migration.

There is, however, a large amount of evidence that points to local and irregular movements of large numbers of this species. Nearly all of this presents the Squirrel in the rôle of a long-distance swimmer.

Squirrels in the Water

The Red-squirrel is known to be a strong and fearless swimmer. Dr. C. H. Merriam, in his "Mammals of the Adirondacks," gives numerous instances of Red-squirrels fearlessly launching out to swim across rivers and lakes of great width,—among the latter, Big Moose, where it is 1½ miles wide, and Lake George at its 2-mile width.

Winslow C. Watson, discoursing on Red-squirrel migration, says, in his "History of Essex County": "The autumn of 1851 afforded one of these periodical invasions of Essex County. It is well authenticated that the Red-squirrel was constantly seen in the widest parts [about 7 miles] of the lake (Lake Champlain), far out from land, swimming towards the shore, as if familiar with the service; their heads above the water, and their bushy tails erect and expanded, and apparently spread to the breeze. Reaching land, they stopped for a moment, and relieving their active and vigorous little bodies from the water by an energetic shake or two, they bounded into the woods, as light and free as if they had made no extraordinary effort."[1]

Alton S. Pope, of Brookline, Mass., tells of seeing a Red-squirrel swimming Attean Lake, Me., where it was between a quarter and a third of a mile wide. It was going at the rate of nearly a mile an hour, but seemed chilled and tired.[2]

Leon J. Cole, of Madison, Wis., writes that on Sept. 18, 1921, while at White Sand Lake, Vilas Co., Wis., he saw a Red-squirrel land after swimming the lake from north to south, where it was one eighth of a mile across. His guide said that for some days, the Red-squirrels had been doing this—as many as 4 or 5 in one day.

---

[1] Mamm. Adir., p. 217.

[2] Journ. Mamm., May, 1924, p. 134.

As soon as this one landed, another came chattering down a near-by tree. "It would have been easy to interpret the incident as the cordial greeting of a relative who had made the passage earlier, and was anxiously awaiting the arrival of the recent immigrant."[3]

Some of these incidents show the Squirrel unwearied by a two- or three-mile swim; others present him as tired and chilled after a quarter of a mile. Doubtless, the temperature of the water and other circumstances have a bearing on this. It will be noticed that no one reports the creature swimming in ice-cold water.

RANGE AND HAUNTS

The range of the species is sufficiently set forth on Map III (p. 164). All species are changing their range in some way. There is evidence that the Red-squirrel has made a successful solution of its problems—is extending its range.

An interesting item in point is furnished by Ernest P. Walker, of Sheridan, central Indiana. Prior to Aug., 1909, Fox-squirrels were common in the oak and walnut woods about his home; but Red-squirrels were not known to occur closer than 3 or 4 miles northeast of Sheridan. "When visiting his home in March, 1921, the writer learned that the Red-squirrels have now reached the immediate vicinity. His father stated that the Reds are increasing and apparently driving out the Fox-squirrels."[4]

According to William Couper, Red-squirrels do not occur on Anticosti.[5]

Its special haunts are the coniferous woods. It is, indeed, the only true Squirrel in Canada, east of the Plains, that is happy in the fir and pine forest region. Where there are neither cone-bearers nor oaks, there are no Squirrels. In Canada, one may go further, and say that this Squirrel is never far from the spruce woods. It has become dependent upon spruce cones for its main support.

It is the only true Squirrel in Eastern Canada that makes and harbours in holes under ground. There is nothing so safe as Mother Earth; and it is doubtless due to this subterranean habit that the Red-squirrel survives and flourishes, while the Gray- and Fox-squirrels vanish with the vanishing woods.

HOME RANGE

The home range of each individual is, I should say, less than 10 acres. At Duff's Lake, near Carberry, is a grove of oaks that covers about 20 acres;

[3] Journ. Mamm., Feb., 1922, pp. 53–54.

[4] As above, May, 1923, pp. 127–28.

[5] Forest & Stream, June, 14, 1877, p. 300.

yet it is range enough for a number of Red-squirrels to live in year after year. This grove is quite isolated; the Squirrels, to get to it originally, may have had to cross half-a-mile of bare prairie. But the Red-squirrel knows so well how to use a hole in the ground that it can make these open journeys safely, when a more strictly arboreal animal would surely come to grief.

In a grove of 30 or 40 oak trees, east of Carberry, William G. A. Brodie and I, on Nov. 26, 1882, ran down and captured a Red-squirrel, that might easily have escaped to thicker woods farther away; but this small grove was evidently the home region that it knew, and here it would stay.

In Ontario, I have known one of the species to take up its abode in a barnyard, and never leave this all winter to go even 50 rods away. Many a one passes its whole life in an orchard of from 4 to 5 acres. A family of Red-squirrels that I watched for some months at Tappan, N. Y., never, so far as I could learn, went a quarter of a mile from the central home trees.

In the woods about my Connecticut home is the Red-squirrel family elsewhere referred to as the "Singers." These I watch each summer, but I have never seen them a hundred yards from the home tree. If they ventured so far, they would be trespassing on the occupant rights of the next Squirrel family, and be forced to fight or run away. I have, however, observed another family in northern New York, that habitually travel along the fence between a corn-crib and a woods over a quarter of a mile off.

At his country home (Woodstock, N. Y.), Paul Doherty had, he tells me, a pair of Red-squirrels which were very easy to observe, as both were albinos. Their nest for two or three years was in a hollow apple tree. They were usually seen within 50 feet of this. Only once in four months did he see them farther away; they were then at the next house, 80 feet from their nesting tree.

From these various facts, I conclude that, in a district of abundant food, a Red-squirrel may pass its life on half a dozen acres. In a region of scarcer food, it must range farther; but if driven half a mile from home, it may be an utter stranger to the locality. The cases noted in the section *Squirrels in the Water*, are exceptional.

THE EXPRESSIVE TAIL

Like all the tribe, this species has a very tender tail; if suddenly lifted by it when alive, the skin is likely to strip off, leaving the raw, bony structure. This is a serious handicap, as is proved by the fact that a tailless Squirrel rarely survives for long. The loss seems to limit its jumping power; and when it falls, it suffers a heavy jar, from which the tail might have saved it.

Yet it is a remarkable fact that half of the Squirrels I collected about

Kenora in 1886, had some injury to the tail—either it was lacking a few joints, or it had an abnormal bump on the end. I do not know whether these were caused by battle, disease, or climate.

At St. Johnsbury, Vt., a friend of mine, Charles H. Horton, had two or three large trout in a fountain basin on the lawn. A Red-squirrel that lived in the adjoining grove came at times to drink here. One day, having satisfied his thirst, he faced about. A distant Cat aroused his ire. He scolded as he sat on the edge of the basin, and lashed his long brush over it in true Red-squirrel style, till one of the trout leaped from the water and seized the tail. Of course, it stripped off, leaving the raw bone. The wrathy Squirrel, rushing up the nearest tree, had the unique experience of seeing the trout play games with his tail in the water below. He chattered and scolded furiously for about five minutes, then went off. The injury seemed slight; the naked part dried up and dropped off. The animal was not obviously disabled, and yet, as usual with such mutilation, he soon disappeared. Robbed of his rudder for the long flying leap, and of the parachute to break his fall, he was crippled in the struggle for life, and did not long survive.

Francis Dickey, of Carberry, Man., writes me that on March 20, 1905, he found a Red-squirrel dead under a tree. "The tail was gone, except half an inch of stub, which looked as if chewed off, and not cut with a knife."

FOES—IN FUR AND FEATHERS

The principal killer of this animal in primitive regions is the Pine Marten; indeed, we may consider that next to the Mice, the Red-squirrel is the Marten's chief food. Nimble though the Squirrel may be, the Marten can follow just as fast. Up the tree and down, and from branch to branch, pursuing to the topmost twigs, turning when it turns, climbing where it climbs, leaping where it leaps, the Marten surely runs it down, and revels in its blood.

The Squirrel has but two ways of escaping. The first is by getting into a hole that is a snug fit for itself, and therefore impossible for the foe—not by any means a safe resource, as the Marten may tear the entrance a trifle wider, and then take the prey at leisure. The other is the flying leap from the branches of one tree to another. The Marten can leap quite as far as the Red-squirrel—that is, four or five feet on the level—but its greater weight forces it to leap from a point farther back, where the boughs are thicker; and this difference is often the salvation of the hunted one. A Squirrel knows all the far leaps that are found in its home range. If it sticks to that, it may escape. But a Squirrel that loses its head, and allows itself to be driven into strange territory, is certainly lost.

The other Weasels also are among the foes of the Squirrel. They have not the activity of the Marten, but they can follow the Squirrel into any hole, and their pertinacity makes up for their inferior agility in the trees.

We must also reckon among its enemies most of the large hawks and owls. According to Fisher's Report,[6] the marsh hawk, Cooper's goshawk, redtail, redshoulder, broadwing, and barred owl have been taken with parts of Red-squirrel in their stomachs. To these, we may safely add the great horned owl, for it is known to kill Fox-squirrels; doubtless, therefore, the Red-squirrel also is on the list.

An interesting chapter showing how the Red one offsets hawk attack is furnished by Dan McCowan. "A Squirrel," he says, "sunning himself on top of a telegraph pole, would appear to be inviting trouble from predatory birds. Observing one in such a position, and that close to a hollow tree stump wherein a brood of hungry hawks were being reared, we marvelled at his temerity. Suddenly, one of the parent hawks swooped at Rusty on his lofty perch. But he was wide awake, and wiser than we reckoned. The pole bore several cross-arms upon which were stretched many wires. Amongst these, the Squirrel was screened, and safe from the talons of the swift-winged hawks; and there he remained until the danger of attack was, for the time, over."[7]

Strange to say, we must include the sparrow-hawk as one of the enemies of the Red-squirrel. I find the following record in my journal:

Portage la Prairie, April 26, 1884.—A male sparrow-hawk was brought to me. In its stomach were a young Red-squirrel and a song-sparrow, an extraordinary meal for so small a bird. Possibly the sparrow-hawk was seeking for a home when it discovered the Squirrel's nest with the young one, and yielded to temptation.

Enos A. Mills offers two interesting observations, showing the Squirrel's different reactions to different enemies. A Squirrel next Mills's cabin was eating a pine cone. "An owl," he says, "flew into the woods. The Squirrel dropped his cone and scampered up into the tree-top without a chirp.

"Another day, a Coyote came walking through the grove without a sound. He had not seen me, and I did not see him until the Squirrel suddenly exploded with a sputtering rush of Squirrel words. He denounced the Coyote, called him a number of names. The Coyote did not like it, but what could he do? He took one look at the Squirrel, and walked on. The Squirrel, hanging to the cone in his right hand, waved it about and cussed the Coyote as far as he could see him."[8]

---

[6] Hawks and Owls, 1893.

[7] Can. Forest & Outdoors, Dec., 1924, p. 761.

The Red-squirrel has another foe to contend with—probably the worst of all; that is the *paralysis of fear*. The very sight of the relentless, bloodthirsty Marten or Weasel on its trail will sometimes rob it of all power, and render it an easy prey.

Enemies in the Water

As we have already seen, the Red-squirrel is a fearless, long-distance swimmer, undertaking over-lake journeys of one or two miles. During these, it is especially subject to attacks from enemies that do not otherwise enter its life.

William Todd, of Richmond, Va., relates that on Baskahegan Lake, Washington Co., Me., about Sept. 10, 1913, he was paddling along, when suddenly there was a swirl near the canoe, and up came a Red-squirrel. It clutched the paddle, ran up a little, fell off, and was left behind in the wake of the canoe. At once, a pickerel arose, and seized it. The tail of the Squirrel was the last thing to disappear. No doubt, the Squirrel was swallowed whole. Where it came from originally, or how in the water, no one could tell.[9]

Leon J. Cole writes that recently he "learned from a colleague, Prof. William H. Wright, that on Aug. 15, 1921, he caught a 'pickerel' (great northern pike, *Lucius lucius*) 37 inches in length, and weighing a little over 11 pounds, which contained in its stomach a full grown Red-squirrel." This was at Lake Fanny Hoe, Mich.[10]

Even more emphatic is the testimony offered by S. S. Green. He writes: "While on the French River, I met a man from Cleveland, who informed me that he had caught two muskallonge, and that each had a Red-squirrel in its stomach."[11]

Another menace is indicated by Benjamin F. Howell 3rd. In discussing the Red-squirrels that are often seen swimming across the arms of Moosehead Lake, Me., he says: "I think some of them must come to grief, however, while out on the lake where the ever-watchful gulls can discover them, for on Hogback Island, where there is a large nesting colony of herring gulls, one can almost always find the remains of Squirrels, which look as if they had been brought there by the gulls."[12]

---

[8] Watched by Wild Animals, 1922, p. 161.

[9] Personal conversation.

[10] Journ. Mamm., Feb., 1922, p. 54.

[11] Forest & Stream, Oct. 14, 1911, p. 590.

[12] As above, Sept. 30, 1911, p. 521.

The following suggestive note by L. R. Dice is good evidence of yet another aquatic enemy. "A Red-squirrel," he says, "struggling with a half grown Mink, was noted July 15, 1912, on the bank of the Kuskoquim a short distance above the mouth of the Takotna River. Our boat drifted by before the result of the struggle could be determined, but the Squirrel was constantly screaming."[13]

So far, no one has recorded the snapping turtle as a destroyer of the Squirrels; though there can be little doubt of its guilt whenever opportunity occurs.

PARASITES

Parasites are merely little enemies—and the smaller they be, the worse they are.

The Common Deer-mouse is found in the same regions, and has the same foods as the Red-squirrel; so I suspect it will be found tapping the Red-squirrel's hoards, just as the Field-mouse often quarters itself on the storehouse of the Yellow Ground-squirrel.

The cuterebra, which is fully described in the Gray-squirrel Life, (p. 54) is known to attack most small rodents. I never saw a case among Red-squirrels, but W. R. Hine tells me that he has seen several about London, Ontario, and one or two among specimens taken near Winnipeg. In these cases, the larvå of the bot was found in the scrotum of the Squirrel.

In the fall of 1888, near Toronto, I saw a Red-squirrel rubbing his anus very hard on a tree, as he chattered at me. On collecting him, I found the anal glands and the surrounding region much swollen. Whether this was some disease, or a sexual condition, or the result of an attack of cuterebra, I could not make out. I have seen it several times since, and always in late summer or early fall. Two well-marked cases were Sept. 11, 1905, at a place 40 miles east of Kippewa, Que.; and Sept. 22, 1902, Bitterroot Mountains, Ida.

The following from my Journal is suggestive:

Wyndygoul, Conn., Aug. 13, 1905.—To-day I watched a large female Red-squirrel (evidently in milk) energetically scratching her head with both paws. Sometimes she scratched and nibbled at her body and tail, but the head seemed the chief seat of the irritation. Occasionally I saw her mandibles moving as though eating the victim of the hunt. At times she stopped to seize and devour a hemlock cone; and several times she rubbed her face and neck vigorously on the hemlock limbs.

---

[13] Mamm. Alaska, p. 26.

A curious sort of parasitism is found among animals which build an elaborate nest, and I have several observations to show that the Red-squirrel is no exception.

I found an abandoned nest of the species late in September, and sent the whole thing to Professor Edmund B. Southwick, who thus reported:

"After a careful examination of the Squirrel's nest, I find among the lining:

"(a) The leg and thorax and larva-skin of beetle—I think, those of the 'meal worm'—no doubt attracted there by the bits of grain, on which it feeds in the larval state.

"(b) The pupa case of fly. As there was a lot of Squirrel excrement in the nest, it is possible that the fly larva fed upon it, as I could see no signs of any other animal matter that it could develop on.

"(c) The pupa case of wasp. This came from the small nest which you say hung a foot above the bed, and was not included in the Squirrel's boarders."

This is a study in "commensalism"—as the Squirrel had at least two tenants to share his bed and board, and a "squatter" in the shape of a wasp, whose sovereignty was not to be disputed—in fact, commensalism with "squatter sovereignty" hanging over it—not so unlike some other local habitats or homes we have seen.

On July 9, 1906, I found that the nest already mentioned as that of the Singer, was deserted. I sent it complete for analysis to Professor Southwick. I believed that the increase of the parasites had forced the Squirrel to leave it, but this idea was not sustained by the report, which is as follows:

"The nest was composed of leaves of *Quercus rubra* and *alba*, also of *Castanea vesca* var. *americana*.

"Leaves and fibre of *Tilia americana* [the nearest tree was 200 yards away].

"Leaves of *Juglans cinerea* [the nearest was 100 yards away].

"Fibre of *Vitis labruska* and probably of *Asclepius* (species ?) [the nearest was 300 yards away].

"The lower part of the nest was composed of a mass of decaying leaf mould and vegetable matter, excrement, etc., and in this I found the following remnants:

"The pupa case of two species of *Diptera;* the imago developing in the excrement; a very minute fly (*Diptera*) of an unknown species, bred in the fermenting mass, and common to such places; the remnants of wing-cases of two species of *Coleoptera*, probably of the wood-boring kind.

"Two larvæ of some wood-boring *Coleoptera* which will have to be developed so as to determine the variety; parts of wing-case of cockroach, common in woods in moist places.

"I could not find any parasitic animals that would cause the Squirrels to forsake their nest; and if such is the case, they migrate with them, or leave the nest when the host has disappeared."

FOOD STAPLES

The Red-squirrel is, above all things, a cone-eater. He is specialized to live on resinous cones; and where there be no cones, there shall we find no Red-squirrels.

In the great spruce belt from Atlantic to Pacific, he lives on spruce cones. In the pine belt, south of that, he adds pine cones to the list; and in the narrow fringe where the pines and hemlocks are yielding to the oaks, he eats acorns. But nowhere is he found in a country from which the cone-trees are wholly absent.

In the region about the Lake of the Woods, I found him relying on jack-pines for his chief support; about Carberry, Man., spruce, oak, and hazel; about Toronto, white pine; around Greenwich, Conn., he has an abundant and varied choice among the cone-bearers planted for ornament. Of these, there are a dozen species of pine, as many spruces, and several cedars or junipers, as well as hemlocks.

THE WORKSHOP

Every Squirrel has, somewhere in his home-land, a workshop—yes, maybe more than one. This is a convenient perch, often a low stump, or log, but sometimes a branch up high near the main trunk. It soon becomes conspicuous by the pile of husks, shells and scales about. These accumulate to the amount of several bushels in favourite spots.

Osgood notes: "Near Lake Marsh [Yukon] I found one such place 20 feet square, which was covered 6 inches deep with scales."[14]

All through the great Northern forests, these workshops or rubbish piles, are the most visible proofs that we are in the home range of a Red-squirrel family.

Before the crop is quite ripe, the Red-squirrel may be seen industriously cutting off pine cones, fir cones, etc., till the tree is despoiled, and the ground below littered over with the crop. There they lie until the harvester finds time to open each, and carry the valuable part to one of his storehouses.

---

[14] N. A. F., 19, 1900, p. 27.

Here it may be remarked that the Red-squirrel knows the best way of getting at each kind of food. He never opens an acorn as he would a hickory nut; or a pine cone as a chestnut burr. He never attacks a butternut at the thick end, or makes the mistake of chiselling into a nut that does not repay the trouble. Sound-*looking* nuts picked up at a Squirrel's laboratory are invariably found to be empty.

Dice's description of the Squirrel work in Alaska illustrates one or more of these workshops. He says:

"In the fall of 1911, before the snow became deep, spruce cones were collected in great numbers, and either buried in the ground, placed in the branches of trees, piled on the ground, or stored in the old piles of scales. At the bottoms of the trees in which Squirrel nests were placed, piles of cones a foot to two feet in height and extending four or five feet around the tree were made. Near Tanana, the first cutting and piling of the cones was noted September 6, and the work was still in progress, though nearly complete, on October 13. The cones may be cut singly, but often they are cut in the natural clusters of several cones, and stored in that shape. September 6, 1911, near Tanana, a Red-squirrel was watched while he was cutting cones from the top of a high white spruce. The cones were thrown away from the tree by a backward toss of his head, and fell in all directions. He seemed to have no regular method of going over a branch for its cones, and I think several times returned to the same branch."[15]

As we go southward, a greater variety of foods is available. In Minnesota, according to C. E. Johnson, the cedar (*Thuya occidentalis*) is important. "On the seeds of these trees, the animals always seemed to feed abundantly, and the ground in such places was often literally covered with cedar cones."[16]

On the morning of July 5, 1923, a Red-squirrel on the top of the pignut by my house, was busy cutting off the tiny buttons of nuts, letting them drop each with a slight "pit." What the little idiot thought he was doing, I don't know—pruning the tree, finding a pin-head of nut-meat for himself, or keeping other Squirrels from getting them?

They do the same by other green nuts, including the chestnut—while we had them. Why this puzzling and misapplied industry? The nuts would be much better if left a month longer; and by throwing them to the ground, all are brought within reach of many rivals. The explanation probably lies in the fact that the Red-squirrel has been evolved to prey on the seeds of conifers. If these are left to ripen fully, they take unto themselves wings and fly away; whereas by cutting the cone just before it opens, the Squirrel makes sure of the prize.

---

[15] Mamm. Alaska, p. 25.

[16] Journ. Mamm., Feb., 1922, p. 36.

Mushroom Diet

An important food supply in winter is mushrooms, especially of the genus *Russula.* The Squirrel stores them chiefly in the forked branches of the trees. Here they are safe from the snow that would bury them, from the Deer- and Field-mouse that would steal them; and instead of rotting, they dry up, and remain in good order until needed.

I have seen the Red-squirrels storing up these mushrooms in the Sandhills south of Chaska Lake, Man. In the Selkirk Mountains, of British Columbia, on the Ottawa, and on the upper Yellowstone River. The Squirrel's sense of private ownership in a mushroom-stored tree is not so clear as his feeling regarding a hoard of nuts he has gathered.

The observations of many naturalists including Stuart Criddle, Norman Criddle, and Dr. C. N. Bell cited by Prof. Buller, show that the Squirrel sometimes stores his selected mushrooms in hollow trees, old bird-nests, and various other cavities.

During early winter in Manitoba, I have once or twice seen a Red-squirrel dig down through the snow to some mushroom, still standing where it grew, and there make a meal of it.

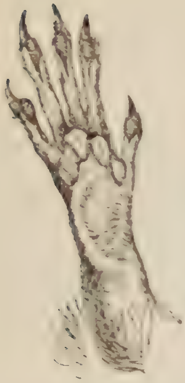
While camped at Caughnawanna, near Kippewa, Que., on Sept. 14, 1905, I was witness of a comic display of frugality and temper on the part of a Red-squirrel. A heavy footfall on the leaves had held me still to listen. Then appeared a Chickaree labouring hard to drag an enormous mushroom. Presently it caught in a branch; and the savage jerk he gave to free it, resulted in the "handle" coming off. The Squirrel chattered and scolded, then seized the disc; but again had the misfortune to break it, and now exploded into wrathful sputterings. Eventually, however, he went off with the largest piece, and came back for the fragments one by one. The scene was an exact reproduction of one described by Dr. Merriam in 1884.[17]

At Banff, Alta., Aug. 17, 1899, I saw a Pine-squirrel carrying a mushroom (*Russula*) four inches broad, up a tree, where he placed it in a fork near another already there, and went for a third.

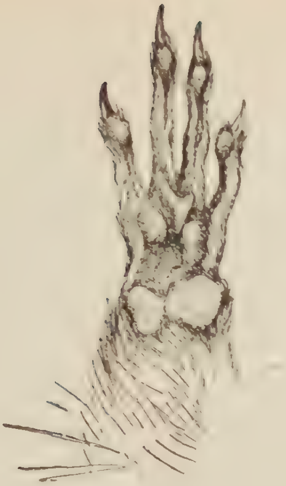
Speaking of the Squirrel in Alaska, Dice says that on Oct. 1, 1911, one "had a nest on a shelf in an old cabin north of Tanana. This Squirrel had collected a great many mushrooms, and stored them on the shelves. Those not entirely dry were spread out separately from the others. Every open can in the cabin was packed tightly with the dried fungi. A grouse head, later

---

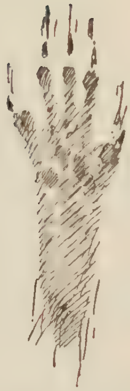
[17] Mamm. Adir., p. 214.



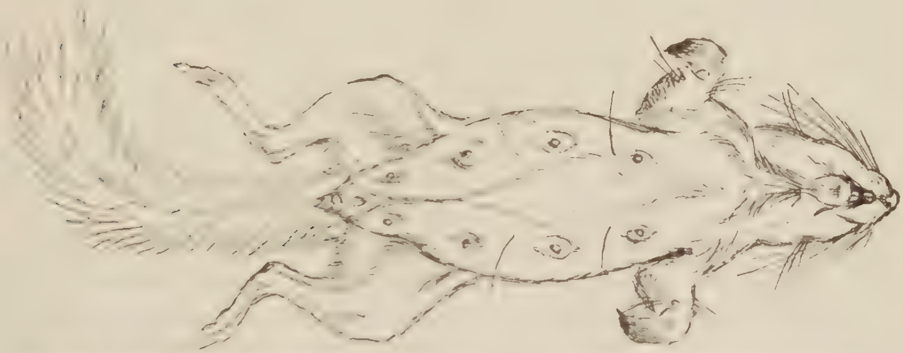
Right hind paw
(Natural size)



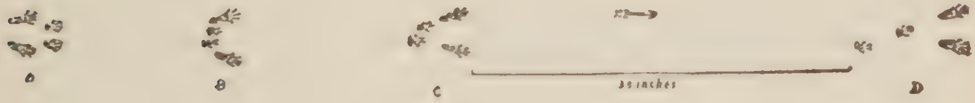
Right fore paw
(Twice natural size)



Track of left hind paw
(Natural size)



Showing the four nerve bristles on under side, with tufts of same on fore legs, cheeks, etc.



Tracks in snow

PLATE IX.—DETAILS OF RED-SQUIRREL

put out for a Weasel, was picked up by the Squirrel and placed with the mushrooms."[18]

As an endorsement of the Chickaree's instinct and sagacity, Hermit (M. A. Walton), of Gloucester, Mass., writes: "For 13 years, I have made use of the varieties of mushrooms selected by the Squirrels and Wood-mice as edible, and have had no reason to regret my confidence."[19] In other words, he stole their hoard, yet escaped punishment.

However, Dr. Gerrit S. Miller tells me that, in a Red-squirrel's store, he once found a toadstool of a species more or less poisonous to human beings.

A. H. R. Buller of the British Mycological Society, published in 1920 an important paper on mushroom-eating by the Red-squirrel.[20] He assembles a surprising amount of observation, made chiefly in Manitoba. Among the mushrooms listed are those belonging to the genera *Hypomyces*, *Boletus*, *Cortinarius*, and *Hypholoma*. After an 8-page discussion, he concludes:

"*Summary*. The Red-squirrel of North America not only feeds on the seeds of fir-cones, hazel-nuts, etc., but is also an habitual mycophagist. In late autumn, it often collects fleshy fungi in large numbers for its winter supply of food; and it stores these fungi sometimes *en masse*, in holes in tree trunks, old bird nests, etc., and sometimes separately on the branches of certain trees."

BARK AND SAP AS FOOD

An important food supply, in Manitoba at least, is the thinnest greenish outer bark of the quaking aspen or poplar. This is always available, so is not stored up, but gathered as it is needed in time of famine.

Many times, during the springtime, I have seen Red-squirrels licking eagerly the twigs of a sweet birch (*B. lenta*) opposite my window. I could not see that they got anything; they certainly were not removing the bark. I have also seen them lapping at a wound in a sugar maple from which the sap was issuing.

The sapsucker taps numerous trees, such as maple, aspen, etc., to feed on the coagulated syrup, and on the insects caught therein. The Red-squirrel makes the most of this chance, and following the sapsucker, steals the product of its labour; sap and insects both are acceptable. Thus the Squirrel becomes for a season a sort of parasite on the hard-working woodpecker.

---

[18] Mamm. Alaska, p. 25.

[19] Forest & Stream, Jan. 15, 1898, p. 43.

[20] See References.

FRUIT-EATER

In the summer, the Red-squirrel feeds also on nearly all kinds of seeds and fruit. Berries are added, but not to the extent that the Black- and Gray-squirrels use them. The Red is a little unaccountable in some of his tastes. I have known one tear open vast quantities of apples to get at the seeds, without eating any of the pulp, though sometimes he does eat the latter. On June 23, 1906, a Red-squirrel stole an apple from our porch breakfast table, and carried it up a tree. Later, it fell from the crotch where he had lodged it. He had eaten over one fifth of it, but had not reached the seeds. Several apples had been stolen thus.

Prof. Klugh records his Squirrel carrying up a lot of boiled potatoes.[21]

ODDS AND ENDS

In the Selkirk Mountains, Aug. 17, 1899, I watched the Squirrels of the region eating eagerly the worms that infested a sort of gall that formed on the spruce trees (*P. alba*).

Mrs. R. G. Taylor, of Swan River, Man., tells me that, when camping out at Lake Madge, 18 miles south of Benito, Man., Aug. 25, 1924, her party burnt out a huge paper-hornet's nest, up in a tree. When it fell, they found three big combs in it, each 4 or 5 inches wide, and full of grubs or young wasps. Next morning all were gone; they had been carried off by a Red-squirrel who was eating them 30 feet up in a tree. How he managed to lug off and climb with these big round combs was a puzzle.

Eliot C. Brown of Burlington, Vt., sends the following: "I recently witnessed a curious proceeding on the part of a Red-squirrel. It ran to the end of a branch, and there tore off leaves, which it began to eat. Several of these leaves fell to the ground, and on examination proved partly covered by a white mould. In this mould were certain shapes which might have been animal life. The leaves were eaten almost to the end of the mould before being thrown down."[22]

STORAGE HABIT

The storage habit is highly developed in the Red-squirrel, as in all his group. But so far as I have been able to observe, he never buries separate nuts here and there in the ground, after the manner of the Gray-squirrel; nor does he store up any useless husks. He first prepares the food carefully, and hides it in one or two places, usually a hollow log or tree. About Winnipeg, where hollow trees are scarce, I found evidence of his storing food underground.

---

[21] Behaviour, p. 10.

[22] Recreation, Nov., 1898, p. 381.

Prof. Klugh says: "The Squirrel practices three methods of storage: carrying things off to one of its main hoards; burying each object separately, and arranging them in a fork or on a limb. It classifies things that it stores into two classes—hard objects and soft. Hard things, such as nuts and seeds, it either carries to one of its hoards or buries; soft things, such as meat, apples, etc., it arranges about the tree. It thus buries nothing which will mould or decay readily."[23]

Dr. R. G. Waugh at Carberry found the Squirrels commonly carrying off potatoes, and storing them in robins' nests. Many of the nests were filled and heaped up with them.

At Wyndygoul Park, a number of Red- and Gray-squirrels had learned to eat from a tray of stuff put out daily in cold weather. The Grays sit down and eat their food where they find it; the Reds carry it away to eat. The Grays lose interest when their bellies are full; the Reds carry away everything, storing what they cannot eat.

THE RED ROBBER

Most of the Rodentia will eat flesh; some are largely carnivorous; probably all are meat-eaters at times. But the Red-squirrel enjoys the ill repute of being the most carnivorous of his group.

Extreme bird-lovers want every Red-squirrel hunted down and exterminated as the tireless assassin of birds—the worst enemy that the fledglings must endure.

First, let me give some positive evidence for these beliefs.

About noon on June 26, 1905, at Cos Cob, Conn., I heard the shrill squealing of a young flicker, and the angry "*churr churr*" of an old one, varied by a loud "*clape.*" On going to the place, I found a Red-squirrel on the ground with a fledgling flicker. He was deliberately eating the flesh off its shoulders in spite of its squeals and the very poor defence of the mother. When he saw me, he ran up a tree and scolded from a safe place. The little reprobate was soaked with blood to the very eyes.

In the June of 1906, at least three robins' nests in my garden were rifled of their new-hatched young, by Red-squirrels; and in one or two cases the eggs were taken.

In *Recreation* for Nov., 1898, p. 379, from the pen of David Bruce, is a long account of a pair of Red-squirrels that visited the poultry yard every

---

[23] Behaviour, p. 10.

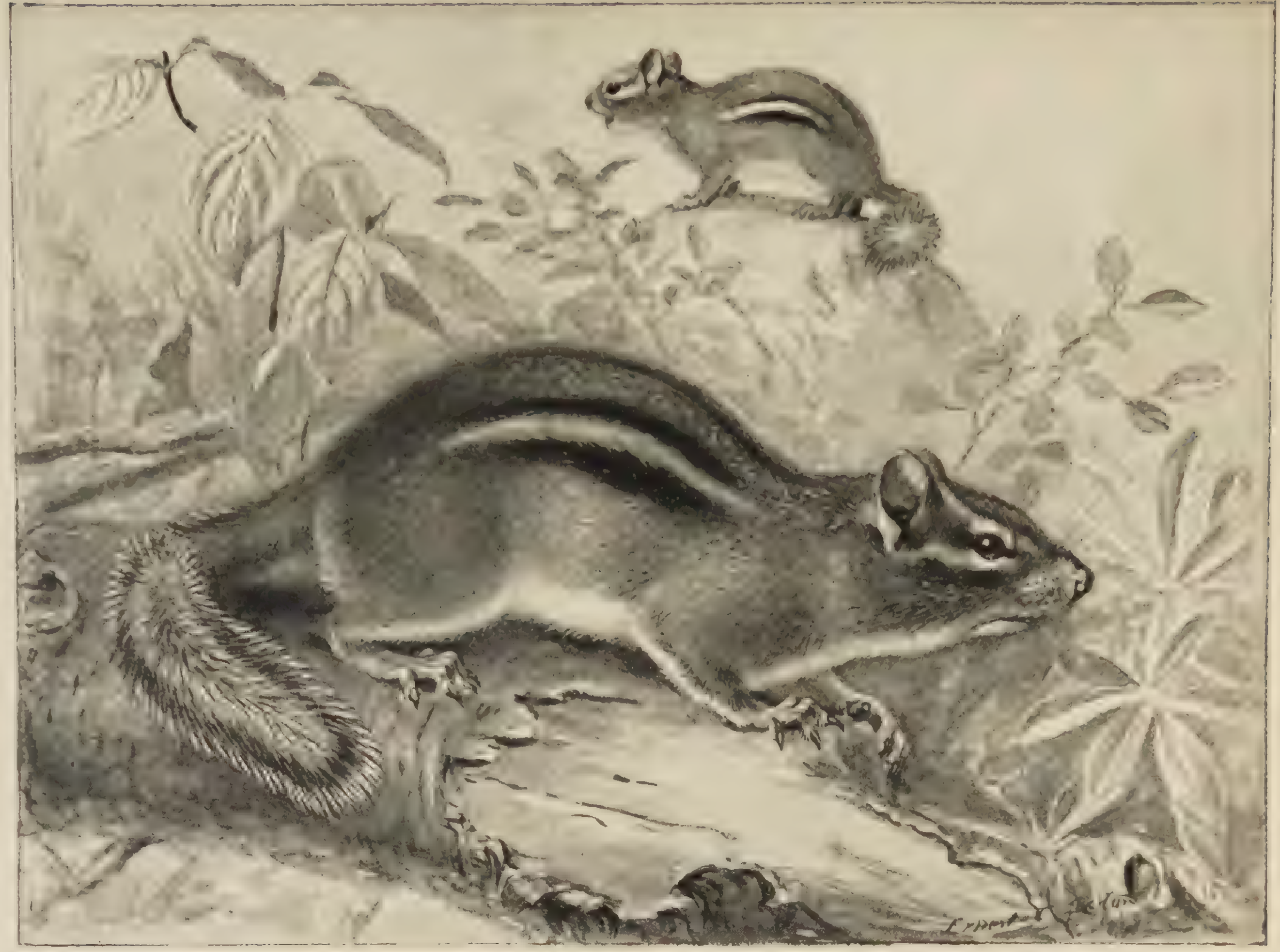


PLATE XIV.—EASTERN CHIPMUNK ($\frac{5}{6}$ LIFE SIZE)

(*Tamias striatus* (Linn.))
Connecticut, September 25, 1906

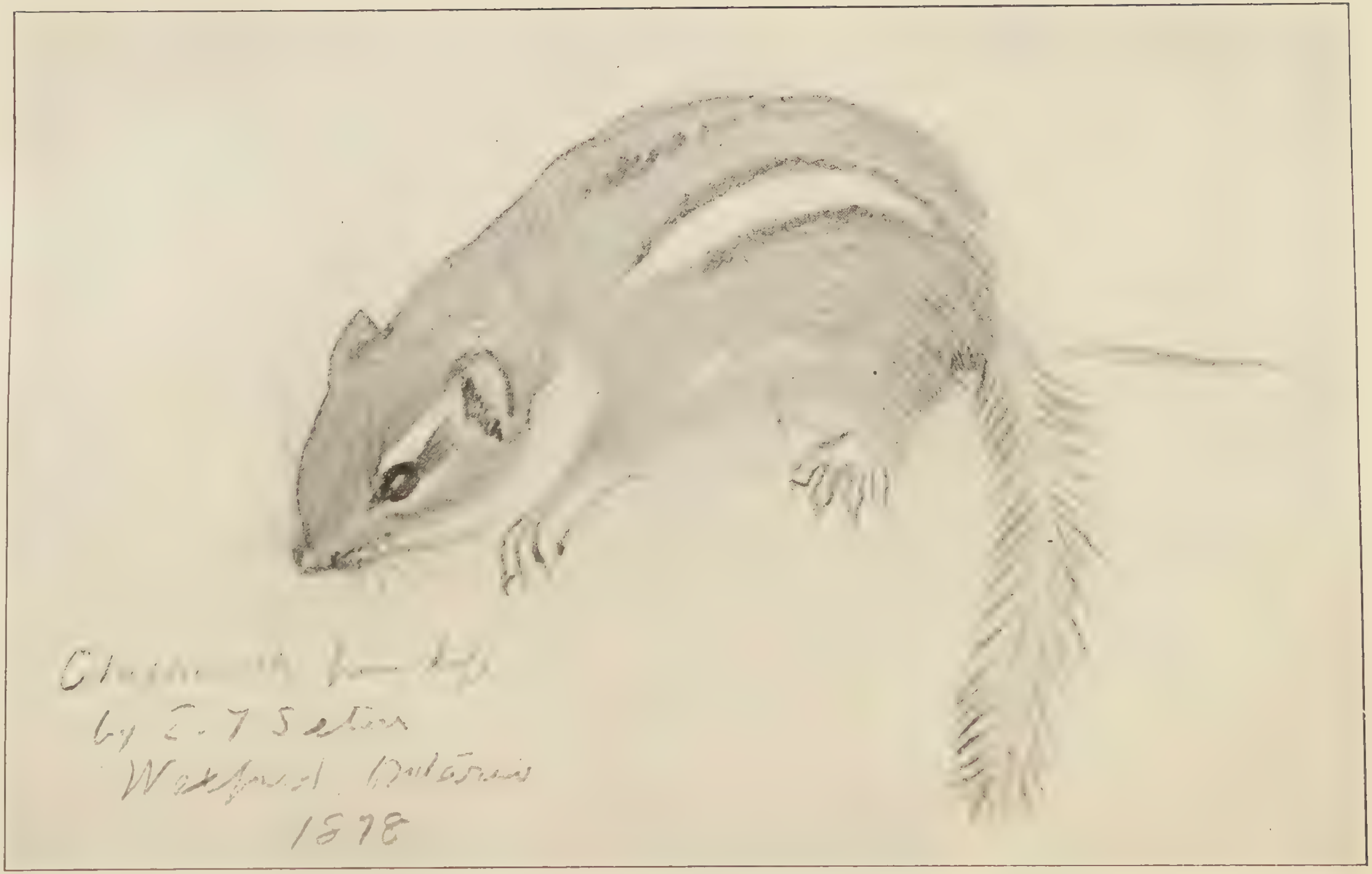


PLATE XV.—EARLY DRAWING OF CHIPMUNK

day for a week, and carried off a chick each time, till a shotgun put an end to their crimes. "Worse than Weasels," the farmer said they were.

Scores of naturalists have gone on record against the Red-squirrel. Finally, I give actual details of a case that I investigated in Manitoba.

THE DESECRATION OF THE SANCTUARY

About 1917, Dr. R. G. Waugh, of Carberry, Man., set about making a bird sanctuary of his 2-acre plot in the town. It was planted with trees, but the house, garage, and lawn occupied over half of the space; that is, there was less than an acre of woods.

By persistently driving off Cats and Dogs, and supplying nesting places and food, he soon had it alive with birds. In 1919 at least 42 pairs of robins were nesting there, as well as wrens, swallows, phœbes, song sparrows, bluebirds, blackbirds, flickers, shorelarks, meadowlarks, chippies, waxwings, and even a pair of crows.

Next year, two Red-squirrels appeared, and the trouble began. Nest after nest was robbed. The Squirrels were seen devouring eggs and fledglings.

In 1921, at least three Red-squirrels were about, and the damage much greater. Not only were eggs devoured, but the nests, eggs, and callow young thrown from the trees in a spirit of wanton destruction. Shrieks from mother birds were daily heard as they vainly opposed the robbers.

In 1922, the Red-squirrels were so evidently ruining the sanctuary, that sentence of death was passed on them. This was carried out with a gun, and then the surprising fact appeared that there were—not a pair, but 14 Red-squirrels on this isolated piece of woods of barely an acre's extent.

In 1923, with the Red Robbers gone, the sanctuary began to recover. In 1924, when I was there, it was again in flourishing condition. Once more, the word "sanctuary" had a meaning, and showed happy results.

What wonder that the Audubon Society has put the Red-squirrel on the Black List as a villain to be remorsely hunted down and destroyed on sight?

THE DEFENCE

The Chickaree has friends, and they are not silent; they point out that the Red One has a definite place in nature. Thanks to him it is that the seeds of pine and spruce are planted deep in the earth where they germinate successfully instead of being picked up by many hungry beaks. The fact that he pays himself with nine-tenths of the crop does not rob this service of its vital significance.

Another large service that he renders, though unintentionally, is being the food of valuable furbearers. When Mice are safe beneath deep snow, the Marten must rely on the Red-squirrel to carry him past the winter pinch. The primitive ranges of the two animals are nearly co-incident—no Red-squirrels, no Martens.

The fruit and grain stolen by the Red One is trifling, and the losses are only on the edge of the forest.

The grave indictment on which he is now being heard, is that he takes heavy toll each year of songbirds' eggs and young. This is a serious charge, well sustained, and yet it is probably exaggerated. For this we know—in the same regions, both Squirrels and birds have abounded as far back as the records go. They must have reached some sort of a balance, showing that they are not incompatible.

Many fair-minded observers point out that, though some Red-squirrels are bloodthirsty little ruffians, these are the degenerates, the freaks. Others are blameless citizens of the woods.

A family of five lived in a clump of trees near my house. In this grove, a yellow-throated vireo reared her young under the Squirrels' very noses. They must have seen the birds, yet did them no harm.

William Brewster has described to me a similar case, in which he saw the Squirrels leap daily over a robins' nest, but offer no harm to the eggs or callow young.

Another witness in defence is Craig S. Thoma, of Vermilion, S. D. Writing to *Bird Lore* on the Red-squirrel as a bird enemy, he relates the robbing of a mourning dove nest and of an oriole; then adds: "But these instances exhaust my list in an experience of 20 years, in a town where Red-squirrels. . . and birds have been associated in about ideal proportions."[24]

A fair summing-up of the case would be: Many Red-squirrels—maybe most—acquire a taste for song-bird eggs and blood. When the crime is brought home, or the villain taken red-handed, shoot him. But do not, on the basis of some evidence, declare extirpatory war on a whole race of beautiful wild animals.

NESTS

Like most Squirrels, the Red has several nests. They serve as sleeping places, nurseries, escapes from hawk-danger, one-night camps, etc. These are made by all individuals, both male and female; and sometimes are the joint work of the pair.

Most building activity is observed in spring and in fall. In my journal, I find this note:

---

[24] Bird Lore, July and August, 1922, p. 206.

"*Nov. 19, 1922* at the Hickory Rocks, Little Peequo, Greenwich, I saw a Red-squirrel hard at work building an outside nest. He paused to chase away a Chipmunk which had appeared in response to the lure of mild weather."

The home nest is usually in a hollow tree or stump. The majority of those I examined were in the abandoned holes of the flicker—a bird that provides more homes and safe retreats for animated nature than any other agency in our country.

In the district around Kenora, Ont., that is, the pine forest, the Red-squirrels build many drays or outside nests. There are a mass of bark strips and roots in the thick top of some bushy tree. One that I examined near Ingolf, Ont., in Sept., 1904, was about 9 feet from the ground in a small jack-pine that stood in a thicket. It was 18 inches across, 14 inches high, made on a solid platform of sticks, warmly built of frayed bark. Evidently the roof was watertight, as inside all was warm and dry in spite of recent heavy rains. The chamber was about 6 inches across, and 4 inches high in the centre. It had but one door; this was on the south, and so draped with fibrous material as to be virtually self-closing and quite concealed.

About Carberry, where hollow oaks and flicker holes abound, these outside nests are rarely seen. On the other hand, in the Far North, where the timber is small, many such are made, doubtless for permanent homes. Dr. W. H. Osgood, writing of the Red-squirrel on the Yukon, says:

"Evidences of its activity are to be found all through the spruce forest. Its globular nests of grass, moss, bark, and refuse are common, . . . and are usually situated near the trunk of some slender spruce, 10 or 20 feet from the ground. Sometimes several will be found in the same tree, and a half dozen or more are very often to be seen at the same time."[25]

Nests in Alaska are, according to Dice, "placed from 6 to 20 feet above the ground in large white or black spruce trees. Often several are found close together in the same tree or in adjacent trees. They are supported by some of the smaller branches, and are usually, though not always, placed near or against the tree trunk. These nests are spherical structures, mostly of dried grass, each nest being about a foot in diameter. No food or excreta was found in the few nests examined."[26]

AN UNCIVILIZED LITTLE BEAST

In the department of sanitation, the lowest animals are those that void their dung wherever they happen to be, even in their nests. But the sanctity of the home is essential to uplift; and the next step is seen in those that leave the nest, but void the waste anywhere near. Flying-squirrels and Ground-squirrels illustrate this.

---

[25] N. A. F., 19, 1900, p. 27.

[26] Mamm. Alaska, p. 25.

A new advance is marked by those which have special places for the product. Of this class are the Field-mice with their open midden-heaps.

The highest types are represented by the Cats, which bury their dung with scrupulous care each time, and the Pocket-gophers which construct underground cesspools or dry-closets.

The Deer, having no home place or nest, need no sanitation, and have not developed at all in this direction.

But the Red-squirrel is inexcusable. The pollution of the nest with excrement is a black mark against him. He has a home, and yet the nasty little beast does not trouble to keep it clean.

As already noted in the section on Parasites, during the spring of 1908, it was obvious that the nesting-box I so kindly furnished my Red-squirrel was deserted after a couple of seasons' use. On May 13th, I climbed, and soon saw good cause. It was crammed to the roof with dung pellets—a sodden and disgusting mass, which left no room at all for a nest, even had the tenants been able to tolerate the smell.

Though unacquainted with the first principle of sanitation, the species has developed some of the fundamentals of government. It will fight bravely for its food-tree, for its territory, for its nest, and, as we shall see, for its mate.

Caught trespassing, however, on the domain of the neighbour, it will act in a cowardly manner that contrasts sharply with the behaviour when defending its own. This may mean that, when at home, it can count on support, and abroad it fears an increase of foes—not that it is a conscience-made coward.

MARRIAGE CUSTOMS

In Manitoba, the mating of the Red-squirrel takes place late in March or early in April. About Toronto, I found the male showing signs, internal and external, of sexual activity as early as Feb. 6. In Alaska, the earliest noted by Dice in 1912, was March 1st.[27]

I have no conclusive testimony to show whether the sexes truly pair, or simply consort for the time being. I have, however, seen two adults at work building a nest; and this is strong evidence, since it is the rule for the male among polygamous animals to shirk all family responsibilities.

Mamm. Alaska, p. 26.

The two albino Squirrels already noted at Woodstock, N. Y., were seen together all summer and autumn.

William Brewster and several other naturalists are of the opinion that the Red-squirrel pairs, and the following evidence has bearing on the question:

On the afternoon of July 19, 1905, at Cos Cob, Conn., I heard a continuous whining "*churr-churr*" from a Red-squirrel in the trees under the window; and I saw, about 10 feet off, a small Red male with very red tail and black side stripes, trying by personal violence to possess a large dull-coloured female. She "*churred*," struggled, and scrambled from bough to bough for several minutes, but he kept his hold. At length, she uttered the loud call chatter. An answer came from a hemlock some 50 yards away; another large Squirrel rushed in, and put the small villain to flight.

I consider this incident important, as it showed, first, sexual feeling outside the true breeding season; next, that the third Squirrel—almost surely a male—still felt a bond of attachment for this female; which argues in favour of permanent mating.

I was further led to ask: Does not fear imply the possession of imagination?

THE COMING OF THE YOUNG

In the North, the dray is often used as nursery, but most of the broods I have seen, were in hollow trees.

Apparently the young are born about the first of May. A home nest which I found at Carberry, June 24, 1882, was 20 feet up in an abandoned flicker's hole in a poplar stub. It contained 5 young. They were then blind, naked, and helpless, and had no sign of aural orifice. They measured each about 4½ inches long, including the tail, which was 1½ inch. While I was up the stub, the mother dashed up and down the far side, running over my hands and arms, in her great distress for their safety, quite reckless for herself.

I put the young back, intending to come again and watch their development. But the mother had other plans for them; she removed them at once, and I did not discover their new abode.

I saw nothing of the male on this, or indeed on any other, family occasion, and so far as I know, he does not usually help in caring for the young.

On the morning of May 4, 1906, at Cos Cob, I found an old female Red-squirrel in a rat-trap alive. She was evidently in milk. On letting her go, she ran up a near tree, in the thick top of which I at once heard a great chattering and crooning as of two or more Squirrels. I suppose mother and family, or possibly the mates, were rejoicing over their reunion after the long separation of perhaps three or four hours.

During boyhood days near Lindsay, Ont., I once felled a dead hollow tree in which was a Red-squirrel's nest. The mother and one of the young were killed by the fall, but the remaining five little ones, still blind and furless, though it was now late in June, were taken to the old Cat with the idea that she would give them a merciful end and turn them to account. But the Cat had very young kittens at the time, her heart was tender, and she received the orphans kindly. She suckled them with her own brood for some days. They died one by one, but it was not the fault of Cat or kittens. So far as we could see, her behaviour toward them throughout was of the gentlest and most motherly kind.

On May 3, 1923, on opening my country house at Greenwich, Conn., I found that a family of creatures, apparently Rats, were nesting in a wall near the garret. They were exceedingly noisy day and night, squeaking, scratching, gnawing. All attempts to catch them with Rat traps proved failures. Their scampering was too heavy and their squeaking too loud for Mice. I decided that they must be Flying-squirrels.

After suffering from their noise throughout the month, I heard them scampering over the floor of the attic about 6 o'clock on the morning of May 26th. Cautiously putting up my head, I came face to face with an old Red-squirrel and two half-grown young ones having a game of tag among the rafters. As soon as they saw me, the mother gave the alarm, and the young disappeared.

Anyone who knows the habits of the mother Red-squirrel will realize that, after such an intrusion on my part, she moved the young ones that very day to some distant nest—where, I have not yet found.

These observations, however, I was able to make:

First, the young ones were active, noisy, nibbling and squeaking more or less all day and all night. They were particularly obnoxious at night.

Second, when the mother scolded on the roof or on the floor of the attic, she punctuated her tirade with heavy stampings of her front feet.

Third, during the night a number of times I heard from the nest a drumming signal exactly like that given by Deer-mice hammering with their front feet, only this was very much louder, and longer. Now, whether this was a similar drumming made by the Squirrel's front feet and intended for a signal, or whether it was simply the accidental pounding of her hock when she scratched the fleas, I cannot say. It seemed, however, much too rapid for the latter.

Once or twice I have seen a Red-squirrel carrying its young. It is not done at all in the same way as a Cat taking her kittens. Rather the reverse, for the Cat clutches the scruff of the neck, and lets legs and body dangle; the Red-squirrel takes the scruff of the belly, so far as I could see. The young one curls around mother's throat, with legs and tail all wrapped tightly around her neck, adding its own small power of clutch, and riding so high that she can run, leap and climb without bumping out the baby's life.

In a box which I set up in a thick hemlock near my house in Connecticut, the Squirrel elsewhere described as the "Singer" reared her brood each year. In June, I often saw the little ones following the old one in a sort of procession through the trees. This is no doubt their training. The mother knows and teaches them all the leaps and bridges, as well as the harvest trees in their overhead world.

A Coming-out Party

A delightful picture of home life in Squirreldom is furnished by R. F. P.[28] In a tree opposite his house, a mother Red-squirrel had half-raised her brood of eight. The Squirrelets, however, considered that they were whole-raised; and one bright day early in June, they took it upon themselves to sally forth into the world. But mother, disapproving the move, set to work to drive and hustle them back by force. She worked frantically, yet it took an hour, for as soon as "she could deposit one wayward child in the nest, another would pop out. Eventually this apparently endless task was completed amid shrill little squeaks of protest at an extra hard nip, and a shove perhaps upside down—it seemed to make no difference.

"As the last small rebel was crowded in, Mrs. R. Squirrel wearily crawled up to the first fork above the nest—the strategic point from which she could command the troublesome situation—and a very determined and threatening parent met the gaze of the most daring little heads which, still hopeful, peeped out. Gradually these futile attempts ceased, and it was easy to imagine eight furry little balls, sighing and whimpering resignedly, as they attempted to ease their smarting reminders of this premature début."

On June 1, 1905, in Wyndygoul Park, a Red-squirrel, apparently a young of the year, but already two-thirds grown, was climbing under the eaves of the house, and seemed to be catching and eating insects. It lost its hold several times on the smooth woodwork, and once it fell with a heavy flop to the brick terrace eight feet below. It seemed hurt, and rubbed its head with both paws in a comical way for a few moments, then ran off to its proper home in the trees.

---

[28] Forest & Stream, Jan., 1924, p. 27.

It was interesting to note that it *rubbed* its head. Had the hurt been elsewhere, it would have *licked* it. In either case, the treatment must be considered an instinctive application of massage to the bruised place.

My journal at Cos Cob, Conn., for June 11, 1905, has the following: "Small Red-squirrels now running alone; they are very red and have very big tails." Again, on June 15, I find this: "The young Red-squirrels of the Singer family are very red in colour and fearless in behaviour. They sometimes follow the old ones, and sometimes run alone."

I think they are not weaned till late in August; at least certain of them are not. The following notes show that some broods are very late.

Aug. 24, 1888, at Lorne Park, near Toronto, a family of half-grown Red-squirrels was found in a stub to-day; the mother carried them off one by one to a distant tree, where she hid them high up from view.

Camp, 40 miles east of Kippewa, Quebec, on Sept. 10, 1905. To-day our guide, Fred Reeves, saw a Red-squirrel carrying a young one in her mouth. She held it by the belly, its legs and tail curled about her neck. It was about one-third grown.

By October, the family seems to have broken up spontaneously. I believe that one brood each year is all the Red-squirrel produces in Canada. Yet E. H. Forbush writes me, April 20, 1920, from Wareham, Mass., that "Red-squirrels had young—a second brood—in the fall of 1919, probably because previous winter was so mild."

A Nocturnal Merry-maker

The true Squirrels are supposed to be diurnal. I had never heard of a Red-squirrel bestirring itself by night, and I am much puzzled by this note in my journal:

Caughnawanna, 40 miles east of Kippewa, Quebec, Sept. 28, 1905. After dusk, I heard in a fir tree the unmistakable "*snick, snick, snick,*" with occasional "*snicker,*" of a Red-squirrel. This was repeated at intervals all evening, until 10:30 P. M., when I went to sleep. At 4:30, when I arose, it was still to be heard. It certainly was not the voice of any bird or of any other quadruped that I know. Is the Red-squirrel nocturnal, or desirous of posing as a nightingale? Or was it some note of the Flying-squirrel?

Since the above was written, I have found the following in the Report of the James F. Bell Expedition: "At our camp on the lower Isabella river, [Minn.] a Red-squirrel, on one occasion, came down after dark from some tall cedars near which our camp fire was burning, to search for food-scraps about the foot of the tree. We had arrived at camp rather late, and the fire had evidently awakened him and induced his little night excursion."[29]

Finally, as already detailed, the Squirrel family in the garret of my house was busy and noisy both day and night.

POWERS

The eye-baffling agility of the Red-squirrel is apt to give a wrong impression as to his speed, and his definite gift of propulsion.

How far can he jump on the level? Not more than 5 feet, I should say, after measuring many bounds recorded in the snow, where the Squirrels were running to escape from Dogs and hunters. The wonderful springs of 15 or 20 feet from tree to tree that one hears of, are made on a descending leap, in which they are greatly aided by the kiting action of the flat-spread body and tail.

Some observations recently recorded by Prof. Klugh increase very little the accredited jumping power of the creature. A leap which his Squirrel many times made was a distance of 8 feet with a drop of 2 feet.[30] But in the second paper is recorded a leap of 5 feet with a rise of 3.[31] This was equal to at least a 7-foot clear jump, maybe more; and is the most I ever heard ascribed to a Red-squirrel.

The strength of this little dynamo is surprising. The apple that he carried up the tree (*See* Food section p. 133) weighed over 5 ounces; the Squirrel himself about 8 ounces. Prof. Klugh tells of his Squirrel carrying a lot of boiled potatoes up a tree; some of these "weighed a quarter of a pound."[32] The Squirrel himself weighed only half a pound. The incident which describes the Squirrel carrying the wasp combs, shows less the strength than the cleverness of the creature, at climbing with a big cumbersome load.

HIS WILDWOOD SONG

The prolonged chatter, the repeated coughing and scolding, and the deep whining that precedes the chatter, are common to all the Red-squirrels. This chatter has much general resemblance to the song of the kingfisher.

In my woods is a Red-squirrel, apparently a female, that is a *singer*. She seems to amuse herself by uttering all the Squirrel notes in rapid succession, going over the list a number of times, and in various combinations, until her performance has lasted ten or fifteen minutes. This is doubtless an unusual individual, but she illustrates the musical habit that we know now to be common to many of the Mouse and Squirrel families, and which may yet be found in all of them.

---

[29] Forest & Stream, Oct. 17, 1914, p. 499.

[30] Behaviour, p. 10.

[31] As above, p. 150.

[32] As above, p. 10.

Dice makes an interesting remark on a solitary Red-squirrel that, for 15 minutes, was working hard cutting his cone-crop near Tanana, Alaska, Sept. 6, 1911. "No other Squirrels were near," he says, "but twice during the 15 minutes, he stopped to give his rattle."[33]

Sociability and Games

Sociable animals do things which are of no direct benefit to themselves, but helpful to others of their species, besides their young and mates. In this highest sense, according to present evidence, Red-squirrels, though slightly gregarious, are not sociable.

They will play together, chasing each other among the trees, but I never saw two of them unite to defeat an enemy or to undertake some work too heavy for single effort. One may give the alarm call on finding a lurking foe; but it seems to utter it as a menace to the foe, not as a warning to its friends.

I have, I believe, seen both parents (near Toronto) gathering cedar bark for the nest; and, of course, the young are often seen in late summer following the mother. But these two cases, being family affairs, do not prove true sociability.

Besides a number of holes in trees and in the earth, I found these Squirrels had a snowdrift playground. They had made a perfect labyrinth of galleries in a drift that was 20 feet long and 6 feet wide. This had ten entrances leading to chambers and passages innumerable, and on very cold days they evidently played tag here instead of in the tree-tops. Around the entrances, I found the remains of nuts and pine cones, so maybe somewhere in the snowdrift was a feasting place—their winter palace was banquet hall as well as gymnasium. But I could not examine it fully without destroying it, so left it alone. (See Plate XII, p. 157.)

This carousel of the Squirrels lay between the graves of a family that had died of smallpox and of some soldiers killed in the Civil War; but doubtless the Squirrels found it the merriest place on earth.

Prof. Klugh's Squirrel, although a lonely 3-year-old male, frequently played a game. "At the top of the trunk of the maple," he says, "at the

---

[33] Mamm. Alaska, p. 25.

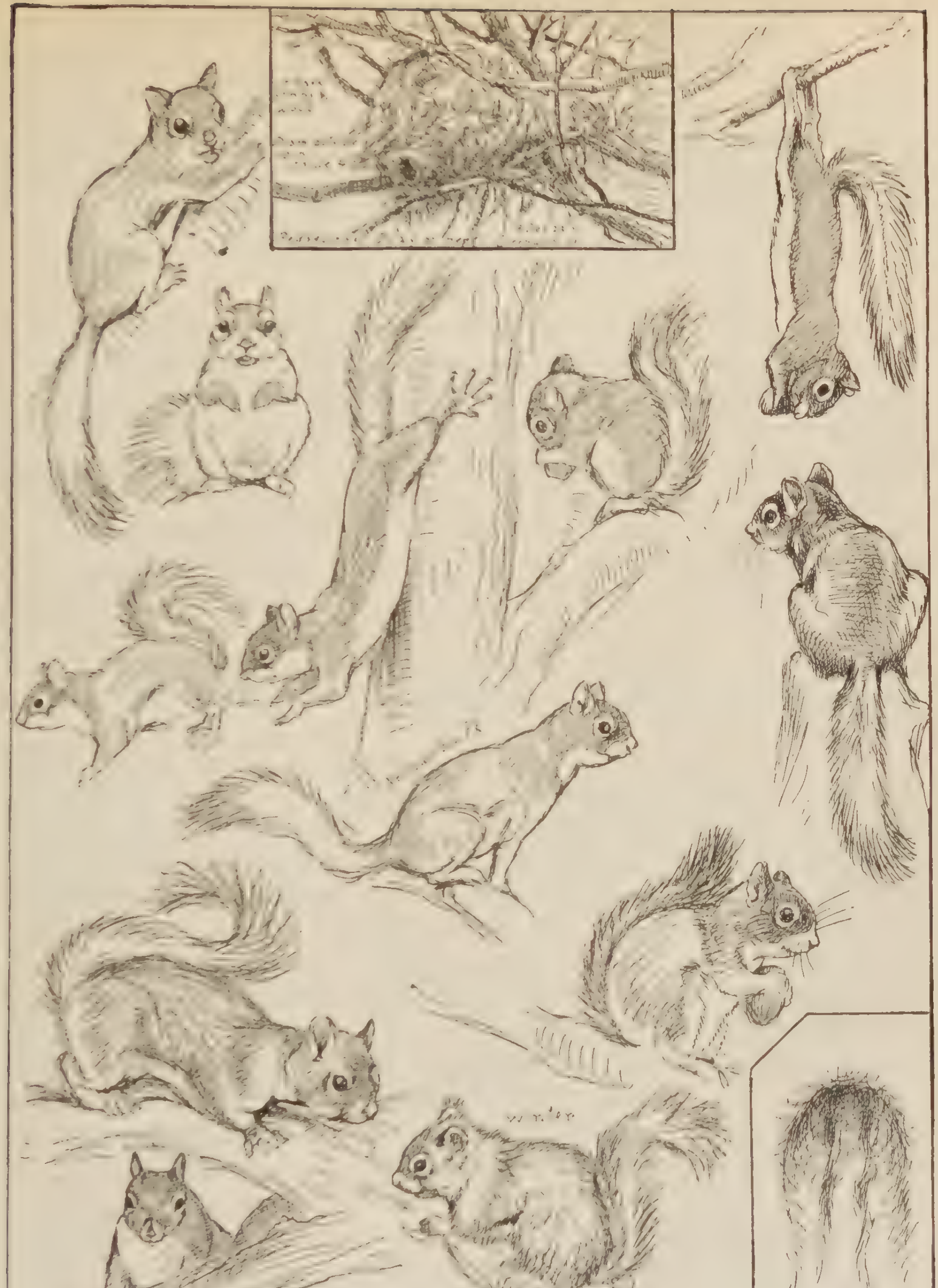


Plate XI Red-squirrel poses etc.

point from which the main limbs are given off, there is a trough-shaped vertical cavity, some 18 inches long, with a pocket-shaped bottom. The Squirrel gets in this cavity, turns over and over in a series of somersaults, sliding down the trough on his back at each backward turn. He sometimes seizes his tail, and rolls about in the pocket, holding on to it."[34]

ODD HAPPENINGS

"Three men working in the woods near here witnessed a most unusual spectacle a few days ago, says a Montreal *Herald* correspondent. They were engaged in cutting wood when a partridge hopped out of the bush and stood motionless a short distance from them. The men ceased work, and watched the bird. Just then a Red-squirrel came out of his den and began chattering. A Dog which had accompanied the men to the woods heard the Squirrel and made a dart toward it. The little animal gave a frightened glance around, and espying what he took to be a stump, hopped on top of it. The motionless object proved to be the partridge, and it immediately rose up and flew away, carrying the Squirrel with it. The astonished choppers watched the unusual sight until partridge and Squirrel disappeared from view, but how far the partridge carried this strange burden, they could not ascertain."[35]

A most interesting case of odd companionship has been put on record by Thomas G. Gentry.[36] "In the hollow of an oak tree, not far from Germantown," he says, "lives an individual of the common Chickaree Squirrel (*Sciurus hudsonius*) with a specimen of this little owl [saw-whet or Acadian] as his sole company. They occupy the same hole together in perfect harmony, and mutual good-will. It is not an accidental temporary association, for the bird and the Squirrel have repeatedly been observed to enter the same hole together, as if they had always shared the apartment. But what benefit can either derive from the other?"[37]

The only explanation that I can suggest is that the Squirrel went there to feed on the Mice and small birds that the owl often stores in one corner of its house. I expect the owl was not benefited at all. Similar cases are mentioned in the Fox Life[38] and Badger Life.[39]

---

[34] Behaviour, p. 151.

[35] Editor, Forest & Stream, Jan. 7, 1911, p. 18.

[36] Coues' Birds of the Northwest, 1874, p. 317.

[37] This incident appears also in Gentry's Intelligence in Plants and Animals, 1900, pp. 281–83.

[38] Vol. I, p. 503.

[39] Vol. II, p. 302.

AGE

Applying the rule that the age of an animal is about five times the period of growth, the Squirrel should be old at about 7 years. In captivity, when guarded from all danger, it may live 8 or 10 years. I have no direct evidence; as side-light, I knew a Gray-squirrel that lived 15 years.

HIS WAY OF LIFE

The Red-squirrel is a veritable Puck-o'-the-Pines—an embodiment of merriment, birdlike activity and saucy roguery. One may live for years near a wood that is the home of Weasel, Skunk, or Hare without ever suspecting its presence, for these sly creatures are silent and nocturnal. But the merry Chickaree is a being of the sunlight, and as boisterous as he is vigorous in work and play. He is well known to all the world that shares his range—and the map shows how very wide a range it is. In various forms the species covers North America, broadly speaking, wherever the spruce trees grow.

The rodents are very low in the scale of intelligence, but the Red-squirrel ranks high in his class. He is gifted with a burning curiosity, which, tempered by prudence and aided by agility, is an excellent start on the road to knowledge. He is an inveterate scold, and will follow a foe for the fun of abusing him at a safe distance. When cornered in a hole, he fights desperately till the last, and will drive his powerful "buck teeth" right through the incautious hand that grasps him, as I have several times discovered to my cost. He considers himself very superior to his larger cousin, the Gray-squirrel, and I take the Red-squirrel's view of the case. Whenever their interests clash, it is the Red-squirrel that wins—in the end, not, I suspect, by any actual battle, but by his vigour, pluck, and pertinacious aggressiveness, which enable him to wear out and drive the other away. I need hardly say, however, that the story of his emasculating his rival is no more than an ancient, picturesque, and sanguinary myth.

There is evidence, nevertheless, that the contest is no foregone issue. On the 2d of January, 1905, I climbed up to the box mentioned in the section on Young. I expected to find the owner at home, as the Red-squirrels were daily to be seen. The box was crammed with leaves and bark strips. A bunch in the centre seemed to move. A finger-thrust proved that a warm, furry creature was within; another poke, and out leaped, not the *prima donna*, but a fat Gray-squirrel, the sole occupant of the nest. If the two kinds are at war, and the Red is the stronger, why was the Gray-squirrel there?

In Zero Weather

This species does not hibernate, so far as my observation goes. I have often seen individuals abroad during very cold weather, even 20 and 30 degrees below zero; and throughout the winter near Carberry. I recollect especially one day in Dec., 1884, seeing the Squirrels chasing each other in a grove of oaks, and having the merriest game of tag, though the thermometer registered that day 35 degrees below zero.

I think it possible that farther north, where the winter is severe, this vigorous little creature may consent to sleep during the worst of the storms, especially during wind; for the habit is deeply rooted in the family. But this must be only for a short time, and he is ever ready to resume active life on the slightest encouragement from the weather.

E. W. Nelson says[40] that in Alaska "the most intense cold of the Northern winter does not keep them in their nests more than a day or two at a time."

During the winter in northern New York State, I found a trail along a fence showing in the snow where some Squirrels had a regular road from a barn full of corn to a little woods a quarter of a mile away. This woods turned out to be first, a cemetery, second, the happy home of a family of Red-squirrels whose playground has already been described.

Tunnels in the Snow

Every winter, at Cos Cob, I found dozens of tunnels driven under the snow as close as possible to the ground. These were of 2- or 3-inch calibre, and at the bottom showed plainly the footmarks of some animal of Squirrel size, working hard to force the passage. Though I never caught the miner in the act, I at length traced them to the Red-squirrel. The remains of cones, etc., in and around showed what he had sought with so much labour.

Prof. Klugh describes in detail a labyrinth of snow tunnels made by his Red-squirrel, but does not consider them a playground. "The purpose of these tunnels," he says, "was to gain access to the keys of the sugar maple which were so thickly scattered about the yard. The Squirrel usually brought them to one of the exits to eat."[41]

Red-coat's Value

As we have seen, Chickaree is of great service in the way of forest planting. It is to his efforts chiefly that the spruce and pine trees owe the safe deep burying of their seeds.

---

[40] Nat. Hist. Alaska, 1887, p. 281.

[41] Behaviour, p. 10.

Next, as we have seen, there can be little doubt that the biggest material service that the Red-squirrel renders is as food for the valuable fur-bearers. Without Red-squirrels in the North woods, we should probably be without Marten. The primitive ranges of these two animals were nearly coincident.

But, after all, his chief value is in his picturesqueness. He is the one live merry wild thing in the big dead silent pine woods. Summer and winter, he is visibly there, alert and musical, bustling and happy. It may prove the part of wisdom to keep down the numbers of his kind in regions where the natural restraints are gone; but I am far from joining with those who would welcome his extinction. Indeed, I should woefully miss the noisy little rascals if I did not see them at their daily play, and I hope that the Red-squirrels will frequent my grounds at least as long as I do.

References

1884—Mammals of the Adirondacks, by C. Hart Merriam, pp. 209–18.

1896—A Revision of the Squirrels of Eastern North America, by Outram Bangs, Proc. Biol. Soc. Wash., Dec. 28, pp. 159–62; 2 ills.

1898—Revision of the Chickarees or North American Red-squirrels, by J. A. Allen, Bull. Amer. Mus. Nat. Hist., July 22, pp. 249–98.

1900—Mammals of the Yukon Region, by W. H. Osgood, N. A. F., 19, pp. 26–28; 2 ills.

1918–19—Behaviour of the Red-squirrel, by A. B. Klugh, M. A., Queens Univ., Kingston, Can. Ottawa *Naturalist*, April, 1918, pp. 9–12; Feb., 1919, pp. 150–52; 3 ills. Intensive study of a certain Red-squirrel, covering 18 months.

1920—The Red-squirrel of North America as a Mycophagist, by Prof. A. H. R. Buller, Trans. Br. Mycological Soc., Vol. VI, Pt. IV, Sept. 22, pp. 355–62.

1921—Notes on the Mammals of Interior Alaska, by L. R. Dice, Journ. Mamm., Feb., pp. 20–28.

LIFE LXIX —DOUGLAS SQUIRREL

PAGE
Names 152
Description: Size, Colour 152
Races 152
Range and Haunts 153
Numbers and Unsociability 153
Nest and Family Life 153
The Voice in the Pines 154
Food of the Wood Child 155
His Mettle 156
His Personality 158

References 159

Douglas Squirrel, Western Chickaree or Red-squirrel, Yellow-breasted Pine Squirrel, Yellow-belly, Piney Sprite, Yellow Piney

Sciurus douglasii Bachman

(L. *Sciurus*, see *ante*; *douglasii*, in honour of David Douglas, traveller and botanist, who discovered the species on the Columbia River about 1824)

Sciurus douglasii BACHMAN, 1838, Proc. Zool. Soc. London, p. 99.

TYPE LOCALITY—Near mouth of Columbia River

When seen in its native pines, this looks like a small blackish Squirrel with bright orange underparts and edging of tail. In most other respects, it recalls the Red-squirrel of the East.

To the generic characters, it adds the following:

Size. Total length, 13 in. (330 mm.); tail, $6\frac{1}{16}$ in. (154 mm.); hind foot, $1\frac{5}{16}$ in. (33 mm.).

Colour. All above, dark olive-brown, finely speckled with buffy yellow; eye-ring, cheeks, lips, and all below, rich buffy orange; tail, edged and tipped with a duller shade of the same; a black stripe on the sides separates the orange from the dark olive.

RACES

Five races have been recognized:

douglasii Bachman, the typical form. T. l., near mouth of Columbia River.

mollipilosus Audubon and Bachman, a small form with white edging to tail. T. l., coast of northern California.

cascadensis Allen, like the preceding, but larger. T. l., Mt. Hood, Ore.

albolimbatus Allen, tail edging white, and underparts in summer pale buff. T. l., Blue Canyon, Placer Co., Calif.

mearnsi Townsend, a pale race with white underparts. T. l., San Pedro Martir Mts., Lower Calif.

RANGE AND HAUNTS

This is strictly a pine and fir wood Squirrel. Its favourite haunts are the heavy coniferous forests from sea level upwards, practically to timberline.

"Go where you will," says Muir, "throughout the noble woods of the Sierra Nevada, among the giant pines and spruces of the lower zones, up through the towering silver firs to the storm-bent thickets of the summit peaks, you everywhere find this little Squirrel the master-existence."[1]

No sooner have we absorbed this sweeping and emphatic blazonment of his exclusively woodland tastes, than we come with a shock on the statement by W. P. Taylor that, on Aug. 6, 1919, his party, surveying Mt. Rainier, found the "Douglas Squirrel playing about in the rocks, apparently very much at home, no less than 2,500 feet above timberline," which is here 6,500 feet above the sea.[2]

At Mammoth, Mono Co., Calif., A. Brazier Howell found them "more terrestrial in habits than are those I have encountered elsewhere. When surprised upon the ground, they practically always seek to escape by running instead of climbing."[3]

NUMBERS AND UNSOCIABILITY

There can be little doubt that this Chickaree is the most abundant animal of its size in the pine forest of the Western mountains. I have passed through many miles of the Douglas fir, where the only sound of animal life was the call of this Squirrel.

It is usually described as common, in all parts of its range, but it is plentiful in some regions, and in others quite scarce.

The Piney Sprite's jealousy about interlopers and exclusive rights amounts to a mania. Less than any other Squirrel is he sociable; that is, disposed to share his kingdom with outsiders. One family in one grove is the rule; and two families in one tree means war.

NEST AND FAMILY LIFE

The Pine Squirrel usually harbours in hollow trees during cold weather; but it would not be true to type if it did not also build nests or drays in the forked branches, for warmer times, when ventilation is more important than heat. Nevertheless Walter S. Perry, of Bend, Ore., writes me that the drays are found only in the South—not in Oregon.

---

[1] Mts. of Calif., p. 226.

[2] Journ. Mamm., Feb., 1920, pp. 93-94.

[3] As above, Feb., 1924, p. 35.

Like its red cousin of the North, it does not hibernate in any part of its range; though Frank Stephens says that in California, during winter storms, "they remain several days at a time in their nests in hollow trees; but in fine weather, they run about on the snow, as if they enjoyed the cold, . . . as they doubtless do. They do not like hot weather, and are not found in the warm valleys or low mountains."[4]

The mating seems to take place in April or May, for, according to Stephens, "the young are born in June and July."[5]

Townsend is quoted by Bachman as saying that the Pine Squirrel gathers quantities of food in late autumn, "assisted by its mates."[6] This co-partnership during the non-breeding season is interesting evidence of permanent union, which is usually associated with pure monogamy.

The young number 4 or 5; and appear, as noted, in June or July, very much later than with others of this group. Stephens says that he has "shot females in August that were then suckling young."[7]

The Voice in the Pines

In my few experiences with this Squirrel, I thought its voice but little different from that of its red-headed cousin in the East. Stephens says: "The voice is varied; commonly a rapid, chirring series of notes is heard, sometimes a sharp yelp, or again a bird-like note. Most of these sounds are emphasized by jerks or wags of the tail."[8] All of which is a pretty fair description of a New England Red-squirrel in full song.

But Stephens, giving a separate account of the Red-wood race, *mollipilosus*, says: "I did not hear the chirring song that is made by most other sub-species, but heard the 'bark,' a monotonous '*quoo*' uttered at intervals of two or three seconds. When startled or disturbed, this is changed to a querulous '*queeo.*'"[9]

Major Allan Brooks, who has had the good fortune to know the Eastern Red-squirrel for years in the East, and the Western for years in its glory among the firs and pines of British Columbia, says of the latter: "The notes are quite distinct from those of the Red-squirrel, except perhaps the trilling chatter, which is the same in both. Douglas Squirrel has a very musical chirp, or rather a soft chirping whistle."[10]

---

[4] Calif. Mamm., p. 90.

[5] As above.

[6] Q. N. A., I, p. 371.

[7] Calif. Mamm., p. 90.

[8] As above.

[9] As above, p. 91.

John Muir, with his usual gift for picturesque presentation, describes this Squirrel as greatly excited on encountering a man. "Finally," he says, "growing calmer, he settles down in a comfortable posture on some horizontal branch commanding a good view, and beats time with his tail to a steady '*Chee-up! Chee-up!*' or, when somewhat less excited, '*Pee-ah!*' with the first syllable keenly accented, and the second drawn out like the scream of a hawk—repeating this slowly and more emphatically at first, then gradually faster, until a rate of about 150 words a minute is reached, usually sitting all the time on his haunches, with paws resting on his breast, which pulse visibly with each word.

"It is remarkable, too, that, though articulating distinctly, he keeps his mouth shut most of the time, and speaks through his nose. I have occasionally observed him even eating Sequoia seeds, and nibbling a troublesome flea without ceasing or in any way confusing his '*Pee-ah! pee-ah!*' for a single moment."[11]

FOOD OF THE WOOD CHILD

Bachman quotes [J. K.] Townsend [of Philadelphia] on the food of this species as follows: "This, . . . like our common Carolina Squirrel, lays in a great quantity of food for consumption during the winter months. This food consists of the cones of the pine, with a few acorns. Late in autumn, it may be seen, very busy in the tops of the trees, throwing down its winter stock, after which, assisted by its mate, it gathers in and stows away its store, in readiness for its long incarceration."[12]

According to Stephens, "the food is quite varied, but consists principally of the seeds of conifers, such as fir, big-trees, sugar pine and yellow pine, berries, nuts, acorns, and chinquapins. Mushrooms and some insects are also eaten. I have caught these Chickarees in meat-baited traps set for other animals. They often store seeds in shallow holes scratched in the ground. A portion of these seeds are not recovered and some germinate. . . . They usually bite off the stems of the large cones, letting the cones fall to the ground, coming down to gnaw their seeds loose, at the foot of the tree."[13]

---

[10] Recreation, March, 1900, p. 190.

[11] Mts. of Calif., pp. 231–32.

[12] Q. N. A., I, p. 371.

[12] Calif. Mamm., pp. 89–90.

Discussing this Squirrel's appetite for cone-seeds, Muir says: "He feasts on all the species long before they are ripe, but is wise enough to wait until they are matured before he gathers them into his barns. This is in October and November, which with him are the two busiest months of the year. All kinds of burs, big and little, are now cut off and showered down alike, and the ground is speedily covered with them. A constant thudding and bumping is kept up; some of the larger cones chancing to fall on old logs make the forest reëcho with the sound.

"Other nut-eaters, less industrious, know well what is going on, and hasten to carry away the cones as they fall. But however busy the harvester may be, he is not slow to descry the pilferers below, and instantly leaves his work to drive them away. The little striped *Tamias* is a thorn in his flesh, stealing persistently, punish him as he may. The large Gray-squirrel gives trouble also, although the Douglas has been accused of stealing from him. Generally, however, just the opposite is the case."[14]

"Nature has made him master-forester, and committed most of her coniferous crops to his paws. Probably over fifty per cent. of all the cones ripened on the Sierra are cut off and handled by the Douglas alone, and of those of the Big Trees perhaps ninety per cent. pass through his hands: the greater portion is of course stored away for food to last during the winter and spring, but some of them are tucked separately into loosely covered holes, where some of the seeds germinate and become trees."[15]

So far, the Douglas Squirrel has not been charged with birdicide.

HIS METTLE

"Though only a few inches long, so intense is his fiery vigour and restlessness, he stirs every grove with wild life, and makes himself more important than even the huge Bears that shuffle through the tangled underbrush beneath him. Every wind is fretted by his voice, almost every hole and branch feels the sting of his sharp feet. How much the growth of the trees is stimulated by this means it is not easy to learn, but his action in manipulating their seeds is more appreciable."[16]

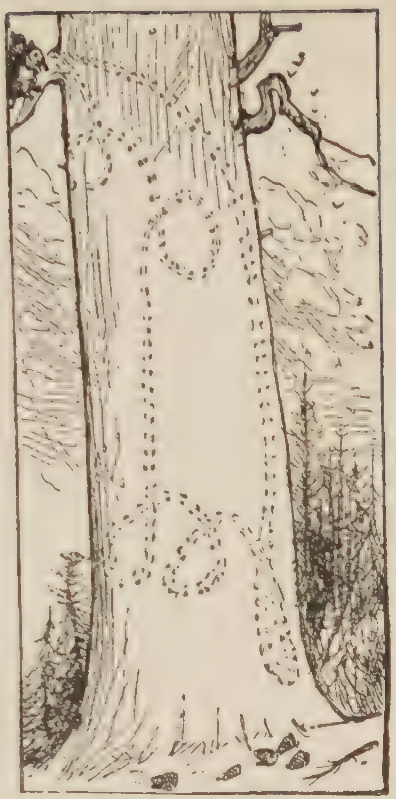
"Seeing a man for the first time," continues the Sage of the Sierra, "he approaches nearer and nearer, until within a few feet; then, with an angry outburst, he makes a sudden rush, all teeth and eyes, as if about to eat you up. But, finding that the big, forked animal doesn't scare, he pru-

---

[14] Mts. of Calif., p. 235.

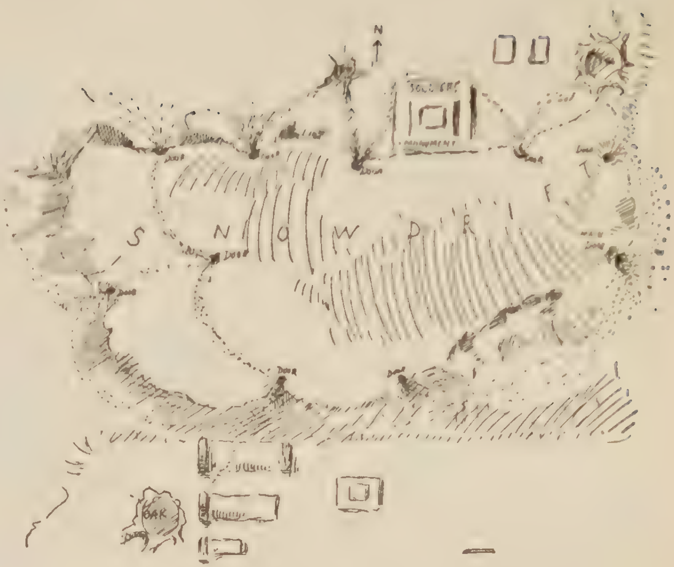
[15] As above, pp. 226–27.

[16] As above, p. 226.



Track of Douglas Squirrel once down and up a pine tree when showing off to a spectator

By John Muir, *Mts. of California*, 1894, p. 231.



The Red-squirrel's playground, in a snowdrift

PLATE XII.—RED-SQUIRREL PLAYING, ETC.

dently beats a retreat, and sets himself up to reconnoitre on some overhanging branch, scrutinizing every movement you make with ludicrous solemnity. Gathering courage, he ventures down the trunk again, churring and chirping and jerking nervously up and down in curious loops, eyeing you all the time, as if showing off and demanding your admiration."[17] (See Plate XII, p. 157.)

"If you remain perfectly motionless, he will come nearer and nearer, and probably set your flesh a-tingle by frisking across your body. Once, while I was seated at the foot of a hemlock spruce, in one of the most inaccessible of the San Joaquin Yosemites, engaged in sketching, a reckless fellow came up behind me, passed under my bended arm, and jumped on my paper. And one warm afternoon, while an old friend of mine was reading out in the shade of his cabin, one of his Douglas neighbours jumped from the gable upon his head, and then with admirable assurance, ran down over his shoulder and on to the book he held in his hand."[18]

His Personality

"All the true Squirrels are more or less birdlike in speech and movements; but the Douglas is preëminently so, possessing, as he does, every attribute peculiarly squirrelish, enthusiastically concentrated. He is the Squirrel of Squirrels, flashing from branch to branch of his favourite evergreens, crisp and glossy and undiseased as a sunbeam.

"Give him wings and he would outfly any bird in the woods. His big gray cousin is a looser animal, seemingly light enough to float on the wind; yet when leaping from limb to limb, or out of one tree-top to another, he sometimes halts to gather strength, as if making efforts concerning the upshot of which he does not always feel exactly confident.

"But the Douglas, with his denser body, leaps and glides in hidden strength, seemingly as independent of common muscles as a mountain stream. He threads the tasselled branches of the pine, stirring their needles like a rustling breeze; now shooting across openings in arrowy lines; now launching in curves, glinting deftly from side to side in sudden zigzags, and swirling in giddy loops and spirals around the knotty trunks; getting into what seem to be the most impossible situations without sense of danger; now on his haunches, now on his head; yet ever graceful, and punctuating his most irrepressible outbursts of energy with little dots and dashes of perfect repose. He is without exception, the wildest animal I ever saw—a fiery, sputtering little bolt of life, luxuriating in quick oxygen and the woods' best juices. One can hardly think of such a creature being dependent, like the rest of us, on climate and food."[19]

---

[17] Mts. of Calif., pp. 230–31.

[18] As above, p. 237.

REFERENCES

1849—Quadrupeds of North America, by Audubon and Bachman, I, pp. 370–72.
1898—Mountains of California, by John Muir, pp. 226–42.
1906—California Mammals, by Frank Stephens, pp. 89–91.

---

[19] Mts. of Calif., pp. 228–29.

LIFE LXX—FREMONT'S CHICKAREE

PAGE
Names 162
Description: Size, Colour 162
Races 162
Range, Haunts, and Numbers 163
Nests, Mating, and Young 165
The Voice of the Noisy 165
The Food of a Cone-eater 166
His Way 167
Sanitation 168
The Case 168

References 168

Fremont's Squirrel, Fremont's Red-squirrel, Fremont's Chickaree, Rocky Mountain Chickaree, Gray Chickaree, Greenback

Sciurus fremonti Audubon and Bachman

(L., *Sciurus*, see *ante; fremonti*, in honour of Gen. John C. Fremont, whose expedition collected the type in 1842)

Sciurus fremonti Audubon and Bachman, 1854, Q. N. A., III, p. 237.

Type Locality—Rocky Mountains, probably central Colorado

Hopi of N. E. Arizona, *Koll'-che-ow-eh* (Mearns).
Hualapai of Arizona, *Him-mal'-e-ga-ta* (Mearns).

Indistinguishable, when alive, from the Red-squirrel of the East, except by its darker colours, and absence of red tints. The black tail and olive colour are strong features.

In addition to the generic characters, it has the following:

Size. Total length, 14¾ in. (375 mm.); tail, 5½ in. (140 mm.); hind foot, 2⅜ in. (60 mm.).

Colour. In summer: all above, dark olive, thickly sprinkled over with specklings of buff; upper surface of feet, light sienna; eye-ring, cheeks, and all below, white; tail, blackish, the long hairs with whitish tips that form a slight border around it; the black stripe on the sides, well marked.

In winter, it has a band of reddish on the back from the head to the rump.

Races

Five races have been recognized:

fremonti Audubon and Bachman, the typical form. T. l., Rocky Mts., probably central Colorado.

mogollonensis Mearns, similar, but larger, and with back-band brighter and more yellowish red than in *fremonti*. T. l., Top of Mogollon Mts., Ariz.

neomexicanus Allen, like the preceding, but much smaller. T. l., Rayado Canyon, Colfax Co., N. M.

grahamensis Allen, like *mogollonensis*, but more yellow on back, and with tail yellowish above and nearly white beneath. T. l., Graham Mts., Ariz.

lychnuchus Stone and Rehn, like *neomexicanus* but larger and more rufous, and with longer nasals. T. l., Forks of Ruidoso, Lincoln Co., N. M.

RANGE, HAUNTS, AND NUMBERS

In general, Map III, p. 164, shows the range of this Northern species projected into a far south land. A more exact map with full details would give to the Fremont Chickaree all of the fir and spruce forests on the mountains between the pine belt and timberline, from the extreme southeast of Arizona to and into the extreme southwest of Wyoming. It is found between 6,500 and 12,000 feet of altitude in Arizona, but at lesser elevations toward the north. Apparently, it avoids the open pine woods, and, of course, the hardwoods which are below them, descending to the lower limits of its range only where there are gloomy cool fir-clad ravines, to reproduce its congenial Canadian haunts.

While camped on the Mogollon Mountains, near the line between pine and spruce, Mearns wrote that the Tufted-eared Squirrel "here infringed somewhat upon the territory of the Mogollon Chickaree; but," he says, "I never saw the latter forsake the spruces for the pines, nor did I observe any quarrels between the two species, although I had heard that the Chickaree was jealous of any intrusion on the part of its larger neighbour, which it resented by waging instant warfare against it and driving it away."[1]

Mearns found it particularly abundant on Mormon Mountain, whose deep ravines were still filled with snow in early May. On San Francisco Peak again, it was abundant from the upper border of the pine belt at about 10,000 feet nearly to timberline at 11,562 feet.[2]

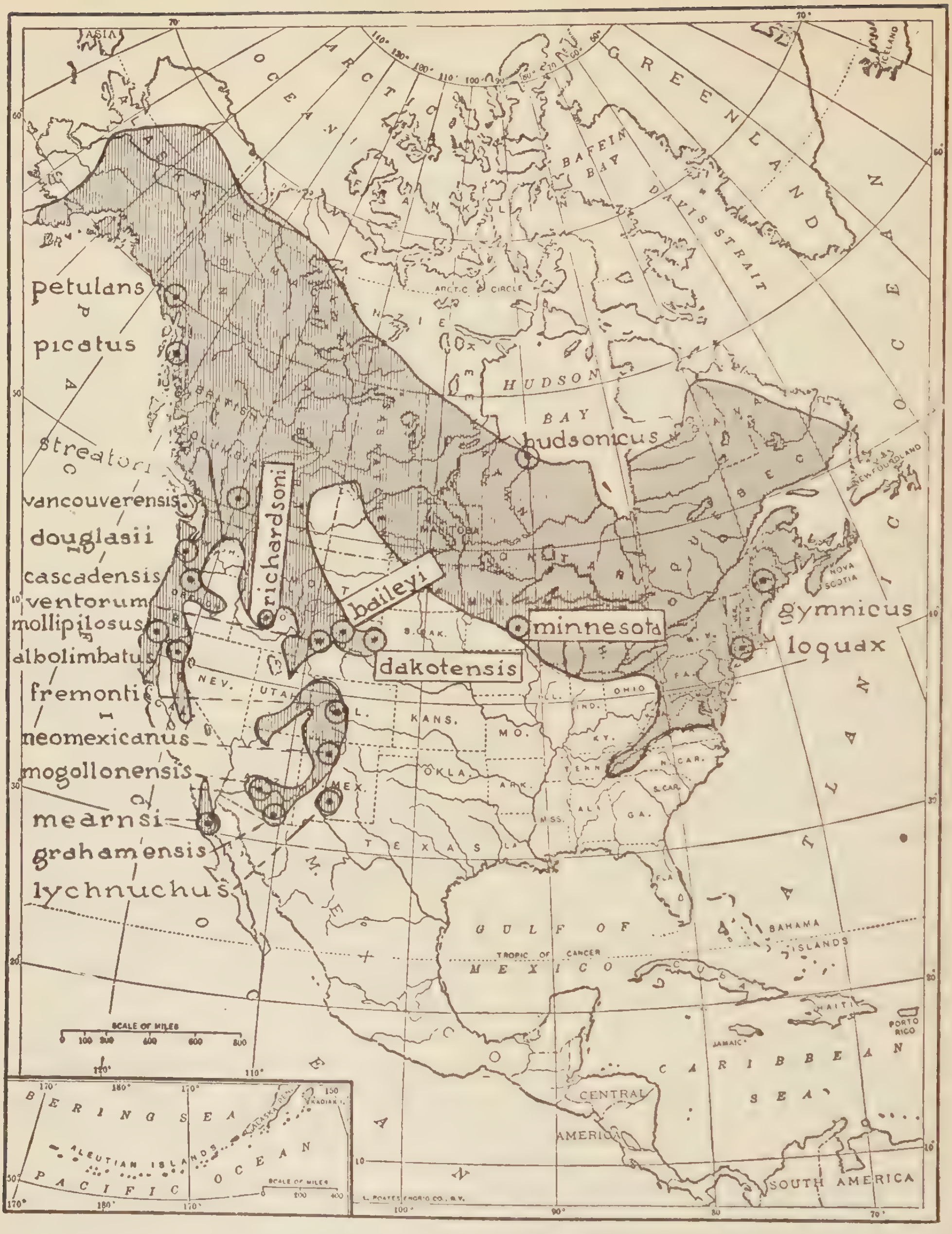
With such a choice of habitat, its range, if fully detailed, would be an archipelago of Canadian islands, scattered over the map of the three States that it chiefly inhabits; and indicating with exactness which areas were above the 7,000-foot level, that is, the lower line of the spruce and fir.

As soon as this boundary is left in going down, the Chickaree disappears. It is reported common in most parts of its range; apparently Mearns found it abundant on the Mogollon Mountains of Arizona.

---

[1] Mamm. Mex. Bd., p. 259.

[2] As above, p. 260.



MAP III.—RANGE OF THE RED-SQUIRREL, OF FREMONT'S SQUIRREL, AND OF THE DOUGLAS SQUIRREL

By E. T. Seton, with assistance of the Biological Survey, 1927

There is some evidence that this Squirrel migrates up and down the mountain, to avoid weather extremes; its summer haunts being near timberline, and its winter range lower down, even entering the pine zone for a way, so that its territory may temporarily overlap that of the big Tufted-eared Squirrel.

NESTS, MATING, AND YOUNG

Its nests are constructed of pine needles, spruce twigs, and bark strips. They are placed on a convenient fork of some evergreen in the dense forest, and are usually 20 to 40 feet from the ground. One which I examined at Taos, N. M., was nearly 50 feet up in a pine, next the trunk. In structure, it was not distinguishable from the nest of the Eastern Red-squirrel. Warren thinks that it also, to some extent, uses underground habitations.[3]

Cary says,[4] that the species inhabits the built nests, summer and winter, and that he never found it living in a hollow tree. But we must remember that, up so high, the trees are small, and hollow spruces are rare. I suspect that it will, like its relative, take to a house-tree by preference whenever the weather gets too cold for camping out.

Warren tells much about a wild Chickaree, that was tamed without being robbed of its liberty. "Charlie," as they called him, "had a mate who was so unfortunate as to be caught in a trap set for the Mountain Rat: he [Charlie] found her before the people did, and attracted their attention by his chattering. They said his grief was pitiful to witness, that he caressed and fondled the body as if trying to coax her back to life, in a manner almost human."[5]

According to Warren, the breeding season is in the spring, and about 4 form a litter. They are born the last of May or early in June.[6]

THE VOICE OF THE NOISY

Its voice and calls are much like those of the Eastern Red-squirrel. It has the same chatter and the same scolding tirade. Cary's remark that "its lively, cheering chatter is one of the few sounds which break the silence of the high mountain forests"[7] is significant; and yet equally applicable to *douglasii* and *hudsonicus;* as well as to the present, and, indeed, to every form of Chickaree that I can get knowledge of.

---

[3] Mamm. Colo., p. 186.

[4] Biol. Surv. Colo., p. 70.

[5] Mamm. Colo., p. 187.

[6] As above, p. 186.

[7] Biol. Surv. Colo., p. 69.

The Food of a Cone-eater

The seeds of spruce and fir seem to be the staples of this Squirrel's diet, but pine and maple are also largely drawn on. Its storage habits are precisely like those of its Eastern cousins, so far as recorded; for it makes innumerable caches, some of them large, under the duff banks that cover the ground beneath its favourite evergreens.

Warren writes me (Dec. 2, 1926): "Near Long's Peak Inn, Estes Park, I found a pile of débris from pine-cones, made by this Squirrel, which was 6 x 7 feet, and 6 to 10 inches deep, as determined by digging through it in several places. I estimated it was at least a half cubic yard—evidently, the result of several years' work, as the bottom layers were pretty well rotted."

Mearns's description of this Squirrel's habits when at home, is practically a description of its food habits. He was prowling through the woods looking for a Bear when first he met this species, and relates the meeting thus:

"Presently a crashing, crackling noise was heard in advance, accompanied by the sound of brushing branches, breaking twigs, and rustling leaves. Crouching in readiness behind a spruce trunk, I imagined the sound was approaching, but it again receded, and curiosity led me to follow it. A moment later, I was nearly hit on the head by a heavy, green pine-cone that came rattling down from a very tall tree-top, cracking off dry twigs in its descent, and then rustling among the dry leaves as it rolled down the steep hillside to the bottom of the ravine. This was immediately followed by another, and then another, until I discovered a couple of these active little Squirrels industriously engaged in harvesting the large resinous cones, and quickly brought one little fellow to bag. . . . On going forward to pick up the specimen, a pile of cones was discovered which would have filled a flour barrel, and more than an equal quantity lay scattered upon the ground. I think they are usually buried in the ground, or in old logs, for winter use, as hollow trees are scarce in such places."[8]

Warren writes me: "Near Long's Peak Inn, I found where the Squirrels were caching green lodgepole pine-cones; and close by were limber pine (*P. flexilis*) cones which had been eaten, but I could not find where any had been stored. Of lodgepole pine-cones 32 were in one hole, and Mrs. Enos Mills told me of finding a much larger number."

This burying of food is the unceasing, normal occupation of these Squirrels in the fall. In September, I found them hard at it in the Flattops of Colorado. Mearns's observations were made in early October. I doubt not

---

[8] Mamm. Mex. Bd., p. 258.

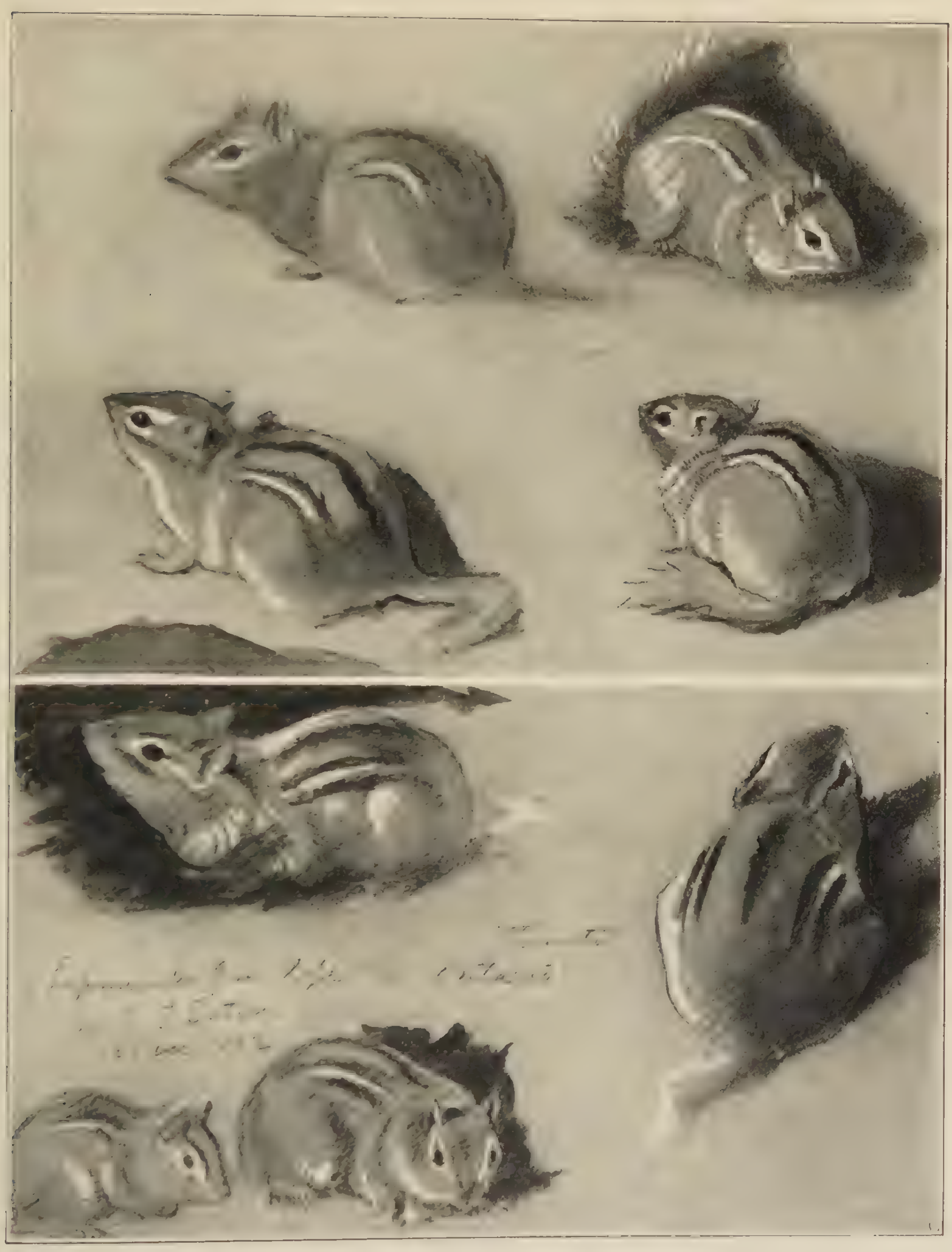


PLATE XVI.—POSES OF COMMON CHIPMUNK

PLATE XVIII.—THE DEMON OF MURDER

Drawn by E. T. Seton, to illustrate Audubon and Bachman's incident of the Brown Weasel that wantonly massacred the Chipmunk family from the time that the fir seeds have any pulp in them, till the frost comes, the Gray Chickaree works at caching food. And much need he has for it, especially in the late winter and early spring.

In the forepart of May, says Mearns, "they were continually digging large holes in the loose soil under the spruce trees, apparently in search of hidden food; and their efforts were so far successful, in that they speedily appeared seated upon some horizontal branch, close to the trunk, and facing the extremity of the limb, noisily tearing open a cone to get at the seeds. Around the huge boles of the spruce trees, large heaps of refuse from the demolished cones attested the industry and vigorous appetites of these Squirrels."[9]

In late May, they were still digging for grub. Late May is early spring in those high, fir-clad mountains; so that there was no new supply of food in sight as yet. In August, he found the species in spruce and maple groves down at the 6,500-foot level, on north hillsides, feeding on maple seed.

His Way

My own observations on the species were made near Taos, N. M., in Estes Park and in Routt Co., Colo. I confess that I saw no trait in this Squirrel, and heard no sound from it, that seemed different from those of its red-headed cousin of the East.

Mearns, whose opportunities for observing it were unlimited, has written some charming paragraphs on its behaviour, as he saw it in camp among the Mogollon Mountains of Arizona in 1887. These I gladly quote:

"While I was preparing specimens in the shade of a tent fly, the Mogollon Chickaree pursued their accustomed avocations within a few feet of me. They were full of curiosity, and by no means diffident. They inspected our tents and equipments generally, even to the Horses' nosebags. They came to the spring and drank, and were open and aboveboard in all their actions, unless their fossorial performances savoured of mystery. . . .

"They are possessed of a large share of the nervous activity and impetuosity which are so characteristic of the Eastern Red-squirrel, which in general, they resemble in habits."[10]

In the deep, dark ravines that furnish its home ground high up near timberline, Mearns found "their pert and saucy manners seemed a trifle modified; still," he says, "they would run down a sloping branch toward me, and stamp and scold in their accustomed way."[11]

---

[9] Mamm. Mex. Bd., p. 260.

[10] As above, pp. 259–60.

[11] As above, p. 260.

SANITATION

None of the Squirrels have progressed far on the trail to sanitation. Most of them are careful to keep their coats, and especially their tails clean; but the proverb about handling pitch and being defiled, is justified in the Chickaree experience while gathering his cone harvest.

"The pelage of the specimens taken at this time," says Mearns, "was much soiled, and matted together with pine and spruce gum, which adheres in sticky drops to the ripening fruitage."[12]

THE CASE

If you go before the Arizona Legislature with a plea for this Chickaree, you are on a hopeless quest; at least, you are if you make an economic appeal. For the members say he is no use to agriculture, and the little good he does by planting trees, is offset by his destruction of cones and of birds' nests.

But go to the children of these men, and you have a better chance. In Chickaree, they see embodied the joyous spirit of wild life in the woods; he is full of vivacity and tireless energy. They would not be without him in the summer camp for many tons of beef and flour. He is a fun-maker. They love him and appraise him far above material things outside their world.

Maybe in these things, the children are wiser than their elders. At any rate, they have influence; and, moreover, they have a majority. So Chickaree—the mischief-making Chickaree—is safe.

REFERENCES

1907—Mammals of the Mexican Boundary, by Dr. Edgar A. Mearns. Smiths. Inst. U. S. Nat. Mus., Bull. 56, Pt. I, pp. 256–64.
1910—Mammals of Colorado, by Edward R. Warren, pp. 185–87.
1911—A Biological Survey of Colorado, by Merritt Cary, N. A. F. 33, pp. 69–71.

---

[12] Mamm. Mex. Bd., p. 259.

LIFE LXXI—THE LEAST CHIPMUNK

PAGE

Names 170

His Kin 170

Description: Size, Colour 171

Races 171

Vast and Varied Range 172

Haunts and Home Range 173

Swarms in Places 173

Mating, Breeding, and Nest 175

Food Habits and Storage 176

His Way of Life 177

His Winter Sleep 180

Wakening up to Sing 180

References 181

Least Chipmunk, Little Chipmunk, Long-tailed Chipmunk, Snow Chipmunk, Western Chipmunk, Painted Chipmunk

Eutamias minimus (Bachman)

(Gr. *eu*, well or good; *tamias*, see next, because this new genus is even more specialized than the older *Tamias*, though along the same lines. L. *minimus*, least)

Tamias minimus BACHMAN, 1839, Journ. Acad. Nat. Sci. Phila., Vol. VIII, Pt. I, p. 71.
Eutamias minimus MILLER AND REHN, 1901, N. A. Land Mamm., Proc. Bost. Soc. Nat. Hist., p. 42, Dec. 27.

TYPE LOCALITY—Near Green River City, Wyo.

FRENCH CANADIAN, *le petit Suisse.*
CHIPEWYAN, *Thal-coo-zay.*
CREE, *Ches-se-cow-e-pis-kus* (Russell).

The genus *Eutamias* (Trouessart, 1880) comprises Chipmunks that differ most visibly from those of the genus *Tamias*, in being much smaller and paler; with longer tails, and two more premolars. The teeth are:

$$\text{Inc. } \frac{1-1}{1-1}\text{; prem. } \frac{2-2}{1-1}\text{; mol. } \frac{3-3}{3-3} = 22$$

HIS KIN

This widely diffused group has recently been discussed by Arthur H. Howell.[1] He credits it with 5 superspecies, which are again divided into 61 races. The superspecies are as follows:

alpinus, very small and pale.
minimus, smallest of the group; of pale colours.
amoenus, larger than *minimus*, with bushier tail.
quadrivittatus, medium sized; yellowish.
townsendii, as large as or larger than the Eastern Chipmunk, and of dark, sombre colours.

---

[1] Journ. Mamm., Aug., 1922, and Feb., 1925.

We have little information about the lives of these. So far as known, they have most habits in common. It seems well, therefore, to treat but one species in detail. For this, I have selected the best known, the one that was most familiar to me in the West, *minimus*, the Least Chipmunk.

The Least Chipmunk has, in addition to the generic characters, the following:

Size. Length about 8 in. (203 mm.); tail, 4 in. (102 mm.); hind foot, 1¼ in. (32 mm.).

Colour. In general, above, it is a brownish gray, much darker on the crown, faintly peppered with darker brown on crown, back, and haunches, and becoming clear orange-buff on the shoulders, sides, and flanks; on the chin, throat, lower jaw, and underparts generally, it is white. There are five black stripes on the body, the central one longest; it begins on the crown and continues to the tail; between the two outer black stripes on each side, is a white stripe which dims on the neck, but reappears at the ear, and continues to the eye. On each side of the head are three dark brown stripes—over the eye, through the eye, and under the eye. The tail is dull orange below; and above, orange overlaid with black hairs. It has a black edging or border, which is broadened toward the end, and is tipped all around with yellow or buff.

When seen alive, its quick movements and noisy "chirrup" attract attention; its warm fawn-colour and black stripes mark it for a Chipmunk; while its smaller size, its freedom from chestnut tint, and its tail held upright, distinguish it from *striatus*, and complete the identification.

RACES

The following races are recognized:

minimus Bachman, the typical form. T. l., Green River City, Wyo.
pictus Allen, a small and pale desert form. T. l., Kelton, Utah.
caryi Merriam, like *minimus*, but pale and rusty, with very white side stripes. T. l., San Luis Valley, Costilla Co., Colo.
pallidus Allen, slightly paler than *minimus*. T. l., Glendive, Mont.
cacodemus Cary, palest member of the genus. T. l., Sheep Mt., Fall River Co., S. D.
consobrinus Allen, like *minimus*, but very much darker. T. l., Wasatch Foothills, 18 miles east of Salt Lake City, Utah.
operarius Merriam, larger than *minimus*, with bushier tail and darker colours; skull more massive. T. l., Gold Hill, Boulder Co., Colo.

atristriatus Bailey, larger and darker than *operarius*. T. l., Sacramento Mts., Lincoln Co., N. M.

arizonensis Howell, like *atristriatus* in size and cranial characters; in colour like *consobrinus*, but grayer, and tail brighter tawny below. T. l., South end of Blue Range, Greenlee Co., Ariz.

oreocetes Merriam, much like *minimus*, but grayer, and with longer stripes. T. l., Summit Mt., Flathead Co., Mont.

borealis Allen, like *minimus*, but smaller and yellower, less bright than *neglectus;* gray on the rump. T. l., Ft. Liard, Mackenzie, Can.

caniceps Osgood, similar to *borealis*, but grayer, particularly the head, tail, and feet; underparts pure white. T. l., Lake Lebarge, Yukon, Can.

grisescens Howell, like *pictus*, but smaller, decidedly more grayish; dark stripes narrow, light ones broad. T. l., Farmer, Douglas Co., Wash.

confinis Howell, similar to *consobrinus*, but larger and more tawny; darker than *pallidus;* like *oreocetes*, but ears with blackish patches. T. l., Bighorn Mts., Wyo.

neglectus Allen, bright-coloured form, tinged yellow on hinder parts. T. l., mouth of Montreal River, Lake Superior, Ont.

jacksoni Howell, like *borealis*, but upper parts more tawny; in general darker. T. l., Crescent Lake, Oneida Co., Wis.

VAST AND VARIED RANGE

This is the common and abundant little Chipmunk of all the wooded country and river valleys in the region given to it on Map V, p. 186. It covers so many faunal areas that we find it split up into numerous races, as indicated.

Preble reported it rather common at Oxford House, Keewatin; and saw one at Pine Lake in the same district.[2] Dr. Robert Bell records it from Nelson and Churchill Rivers,[3] and G. S. Miller, Jr., found it at Nepigon and Peninsula Harbour, Ontario.[4]

Thus, its distribution is that of a Western animal that is working eastward.

---

[2] N. A. F., 22, 1902, p. 45.

[3] Rep. Prog. Can. Geol. Surv., 1882–3–4, App. II, p. 48 DD, 1885.

[4] N. A. F., 22, 1902, p. 46.

Haunts and Home Range

In Manitoba, this species selects the same surroundings as the large Chipmunk; though possibly it is more of a ground animal, as I never saw one up a tree. Farther west and south, it is found in the wastes of sage and rock, remote from any water supply, and with but little cover.

The home range of the individual must be very small. I found a pair living in a little isolated thicket about 20 yards in diameter. I can readily believe that, given food enough, they would not leave this at any time. The case noted later of an individual going a quarter of a mile in search of special food, was, doubtless, very exceptional. Ordinarily, this Chipmunk will, like its larger cousin, pass its whole life in the narrow bounds of a single acre.

"They climb readily," says Nelson, "and often travel from bush to bush through tall thickets like Squirrels in tree-tops. On warm mornings after frosty nights, they may be seen in the tops of the bushes basking in the sun."[5]

There is, moreover, nothing in the nature of a migration among these Chipmunks. This individual fixity, as we have seen, has had the usual result of splitting up the group into a great number of different forms, corresponding with the life conditions of each locality.

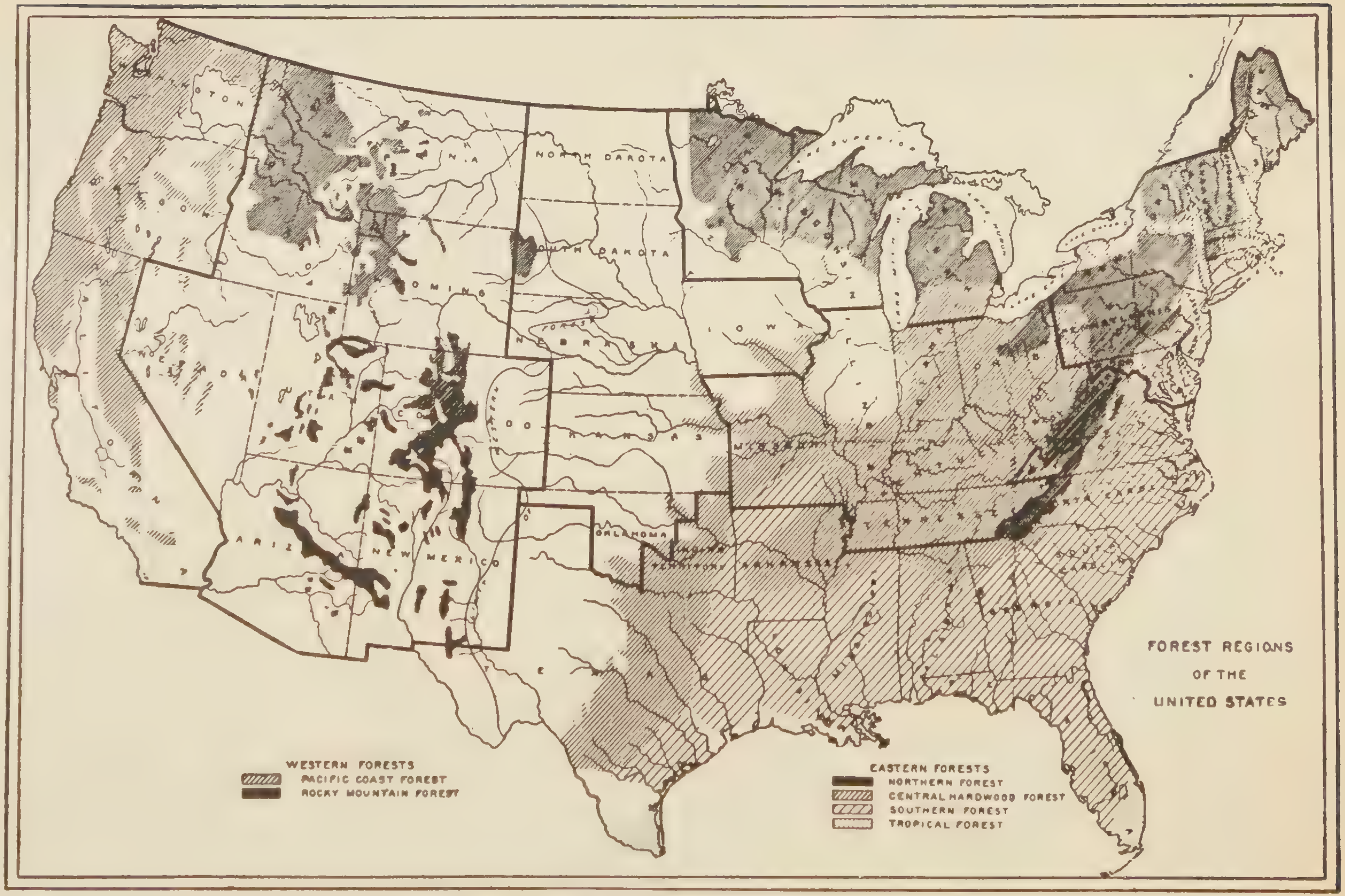
If Chipmunks were given to travel, the races which abound in the South and West, would have been swamped, except where they were the simultaneous product of a large region. But, strange to say, the Chipmunk, as a species, seems less able to transport itself from place to place than are many trees and plants. A Chipmunk or a Pocket-gopher may easily spend its life on the ancestral acre; but the cockle burr may ride the Buffalo, or the thistledown the wind, for twenty miles before settling down to grow and raise a family.

Swarms in Places

This creature is very local in distribution. It may seem rare in a given region; then, suddenly, we come on some place of exceptionally favourable conditions, and find the Chipmunks in numbers. At the old Carberry saw-mill, mentioned later, there were hundreds of these bright little creatures. One could have seen 50 in ten minutes, when the place was a wilderness of ramshackle buildings and lumber piles. I dare say that the acre in which the mill stood, held not less than 1,000 Chipmunks. But this was in the early

---

[5] W. A. N. A., p. 553.



MAP IV.—FOREST REGIONS OF THE UNITED STATES IN 1919, TO ILLUSTRATE THE DISTRIBUTION OF THE SQUIRRELS
From Forestry Department

'80's. In 1892, the mill was gone, and the Chipmunks with it; still about Carberry I thought the species then more generally abundant than in 1883.

In Turtle Mountain, as I learn from A. S. Barton, it is very abundant in some years, and scarce in others. Whether this is due to epidemics, as with the Rabbits, or to famine, or to observational opportunity—as with many species—is yet to be ascertained.

In the Yellowstone Park, it finds (or did in 1897) congenial surroundings along all the main trails. The log heaps at each side are nearly continuous; and the food supply of spilled grain and Horse dung is so abundant that I certainly saw Chipmunks at the rate of hundreds to the mile during the season I lived there.

I find in my Journal the following note:

Aug. 8, 1897. Yellowstone Park, near Fountain Hotel. On the road from Norris (20 miles) saw fully 1,000 Chipmunks; some of my friends said several thousands. In one place 9, in another 10, another 8, another 11, another 20, another 28, another 30, closely massed together about some grain spilled on the dusty road.

This, however, was during the age of Horses. A vast change has been wrought by the automobile. Their numbers are greatly decreased to-day.

MATING, BREEDING, AND NEST

There is a surprising dearth of information on the mating habits of this abundant and familiar creature. The analogy of *Tamias* suggests that it pairs, and that both parents unite in preparing the nest, if not in caring for the young.

While observing a nearly related Chipmunk in the High Sierra of California, I found evidence that its mating season is in September, although the young are not born till the following spring. So far as known, this is not the case with the present species. It is believed to mate in April, and produce some time late in May.

E. R. Warren says of those he observed in Colorado: "As shown by the examination of pregnant females, the number of young in a litter is from 4 to 6, and the breeding season is May and June."[6]

After noting their early spring advent, Nelson says: "The young appear a month or more later; and litters containing from 2 to 6 may be born throughout the summer, indicating the possibility that several litters may be born to the same pair in a season."[7]

---

[6] Mamm. Colo., 1910, p. 180.

W. A. N. A., p. 553.

"On Oct. 23 [at Peninsula Harbour, Ont.]," says Miller, "I found an adult female in a nest built of feathers and soft vegetable fibres, at the end of a tunnel under a clump of bearberry. The tunnel was about 2 feet long and terminated a foot or more beneath the surface in a chamber about the size of a cocoanut. This chamber was completely filled by the nest, which contained, in addition to its occupant, a small store of seeds of various weeds and wild fruits."[8]

Food Habits and Storage

In food habits, this species differs from *Tamias* only in so far as is imposed by different opportunities. Every kind of seed, grain, nut, and fruit, as well as insects and some flesh, are believed to be on its official list. The following notes are evidence of its tastes and habits in this department:

About Carberry, I saw it eating table scraps, particularly bread. At Athabaska Landing, Preble saw it feeding on seeds of *Rosa*.[9] J. A. Loring found it feeding on oats near Edmonton.[10]

L. R. Dice says, in his notes made at Missoula, Mont.: "May 19 [1918]. One was noted eating dandelion seeds while seated on a rock pile at the edge of the cottonwood forest along Rattlesnake Creek. He would cut off a ripe head and then, seating himself on a rock, would cut away one side of the head near the base, and eat the seeds. He was quite wasteful, spilling many of the seeds on the ground. He apparently attempted to eat only the seeds, but I could not be sure whether or not he cut off the seed plumes, though I think he did."[11]

Farther south, his diet is expanded by larger opportunities. Nelson says: "In one locality in Nevada, during June and July, more than half their food consisted of a web worm and its chrysalids with which the sage bushes swarmed. The Chipmunks climbed into the bushes and pulled the larvæ from the webs. As half the bushes were infested, the work of the many Chipmunks had a material effect in reducing the numbers of this pest. The vegetable food eaten includes the seeds of *Ribes*, *Kuntzia*, *Sarcobatus*, pigweed, and many other weeds, service-berry, various grasses, oats, wheat, and the seeds of small cactuses. They regularly climb into the tops of large sage and other bushes for their seeds, and the ground beneath is often covered with the small sections of twigs cut by them."[12]

Like all its near relatives, the Least Chipmunk is furnished with capacious cheek-pouches for carrying food; and assiduously uses them in harvest time to make stores of grain for rainy days to come.

---

[8] Mamm. Ont., Proc. Bost. Soc. Nat. Hist., April, 1897, p. 31.

[9] N. A. F., 27, 1908, p. 168.

[10] Preble, as above.

[11] Journ. Mamm., Nov., 1922, pp. 262–63.

[12] W. A. N. A., p. 553.

Nancy Christenson of Mandan, N. D., tells us that her pet Chipmunk "could carry as many as 21 kernels of corn in its pockets."[13]

Edwin Hollis records[14] that a specimen taken at Touchwood Hills, April 13, 1902, "had barley in cheek pouches, and was quite a quarter mile from nearest barley field or granary, so evidently had a winter store."

As late as Sept. 26th, at Fort Resolution, I saw one carrying home great bulging pouchfuls of skunk-grass seeds.

Closely related to his storage habit, is the one great material service that he renders man. J. V. Hoffman, of the Forestry Service, expresses his conviction that we must thank this Chipmunk for the replanting of vast areas of forest land denuded by man or other reckless and destructive agency.[15]

His Way of Life

This wonderful little animal seems to be a cross between a Striped Squirrel and a song-bird; and the bird that it most resembles is the chickadee—usually confiding, pert, and noisy, but also quick to escape and disappear when in evident danger.

My friend, Miller Christy, gives a vivid and charming picture of the creature in its fearless moods, as he and I saw it about Carberry, Manitoba, in 1883.

"Without exception," he says, "the Chipmunk is in its form and movements the very prettiest little animal I ever set eyes on. . . . In it the fear of man seems to be entirely absent; it seems to run away merely for *fun;* but for all that, you would almost as easily catch a flash of lightning! It is incessantly upon the move, climbing about and over everything as if exploring, and always carrying its long tail bolt upright in such a ridiculous manner that it becomes by far the most conspicuous part of the whole animal. You may see one of these tails, with a Chipmunk attached to it, dodging round a piece of wood and eyeing you keenly, without the slightest appearance of fear, as if roguishly trying to tempt you to catch it. But try! In a moment, with a shrill, derisive, bird-like little whistle, the tail is gone—you hardly know where; till you see it again a moment later, going through exactly the same antics along with several other tails.

"Among the sandhills, a few miles from Carberry, stands an old saw-

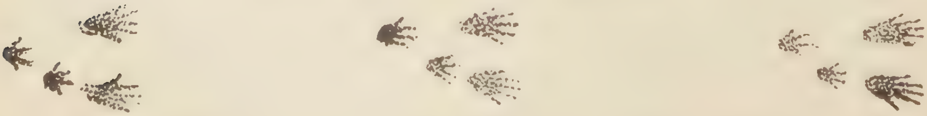
---

[13] Forest & Stream, April, 1925, p. 223.

[14] Zoologist, Aug. 15, 1902, p. 297.

[15] Journ. Mamm., May, 1921, p. 113.

Little Chipmunk. Carberry, Manitoba, 1884.



Tracks of the Little Chipmunk, with intervals of about ten inches

PLATE XIII.—LEAST CHIPMUNK, DETAILS

mill, which is quite deserted during the summer months. Round this mill Chipmunks swarm. Their holes run under its floor; and the creatures themselves are constantly to be seen scaling the walls and scampering over the roof.

"One day when I was at the mill, I found that they had entered by a broken window, had licked clean some unwashen plates left on a bench, and had even taken samples of the eatables left in the cupboard.

"I went on another day to the mill in order to try and catch some Chipmunks alive. This I found a very easy thing to do with a figure-4 box-trap. The animals seemed perfectly unsuspecting. Whilst I was setting one of these, a Chipmunk extracted my small store of bait from the paper in which it was wrapped, and consumed a considerable portion of it. As the little thief scampered off at my approach, with every appearance of laughing at me, he dropped the bread, and I secured it; but I had no sooner done this than on looking round, I found that another Chipmunk was sitting upright on the top of the trap I had just set, nibbling at my bait, which he held in his fore paws, and eyeing me sharply; but otherwise manifesting a coolness and deliberateness of procedure that completely staggered me."[16]

So also writes E. R. Warren: "It is usually quite a shy, restless little animal, but sometimes becomes very tame and bold about camps, and is then rather a nuisance, stealing all kinds of eatables which it may be able to carry away. This, however, is not peculiar to this species, for all the Chipmunks become thus familiar when not molested; and will sometimes become so tame as to take food from one's hand. At one camp in Gunnison County, I once had two or three feeding from my hand, and several others picking up crumbs about my feet, all at the same time."[17]

Under different circumstances, the Chipmunk may manifest wholly different behaviour. Nelson, after many years' experience, sums up thus this bright, playful creature's ways:

"So alert and shy are they that even a person in their haunts day after day will see but few of them. Their hearing is extremely acute, and even at a great distance the footsteps of an intruder sets them all on the alert. On every side, they run swiftly to cover before the observer has opportunity to see them. In such places a large setting of baited traps will reveal their presence in surprising numbers. In one locality, during a brief visit, traps set among the brush for other small mammals yielded more than 40 Chipmunks."[18]

---

[16] Nat. Hist. Journal & School Reporter, York, Eng., May 15, 1885, pp. 70–71; rewritten by the author for this.

[17] Mamm. Colo., 1910, p. 178.

[18] W. A. N. A., p. 553.

His Winter Sleep

Men have for some time made merry over the once-accepted idea that swallows hibernate. The palpable absurdity of it was cause for much cacophonous joy. And yet we know that Bats do hibernate; and finally, that this Chipmunk—the brightest, livest, most birdlike thing that is not a bird, and yet lives in our Northern woods—does hibernate more or less completely.

In the North, according to my experience, about the end of October, this bird-beastie, growing tired of play and frost, finally plugs up his doorway against the cold, the wet, and the Weasel, and curls up for his six months' sleep.

Just how he passes this half year, is not yet recorded. But we find light in the parallel case detailed by A. W. Anthony concerning a nearly related species.

"Many years ago," says he, "I uncovered some two or three *Eutamias townsendii* after they had retired to their winter quarters. I am unable at this time to state the exact date, but as I remember, it was in the late winter, and the location was about 8 miles west of Portland, Ore. The animals had selected a sloping hillside, and were deep under large fir stumps. Each nest was a small bunch of shredded vegetable fibre, in the centre of which the Chipmunk was curled; the tail covering the head and as far along the spine as it might reach.

"Hibernation was complete, the animal being stiff and cold, the flesh almost as if it might be frozen. There was no food either in the nest or in the earth under the stump, so far as could be discovered by human hands. The entire stump was uprooted before we finished the job. No two Chipmunks were found under the same stump, nor, as I recall, near enough to be considered 'neighbourly,' though all were on the same hillside and under similar conditions."[19]

Wakening up to Sing

In spring, the little Chipmunk appears about the same time as the larger Eastern Chipmunk; that is, in Canada, during the first week of April. At Touchwood Hills, in 1902, the first one was seen on April 13th. But its evident dependence on temperature is shown by the fact that in the mild season of 1905, this species appeared above ground at Boissevain, Man., during February, and was therefore dormant but little more than two months that winter.

It seems hardier than *striatus;* for, in the Rocky Mountains of Wyoming and Colorado, I often saw it running over the snow after winter had begun. On one occasion, 9,000 feet above the sea, near Breckenridge, Colo. (in 1899), as late as Oct. 31st, I noted one sitting up and eating under the shelter of a log during a driving snowstorm.

---

[19] Journ. Mamm., Feb., 1924, p. 76.

"A. F. Camsell saw one on the Mackenzie a few miles above the mouth of the Liard about Oct. 26, when 6 inches of snow laid on the ground."[20]

Strange to tell, I have never definitely identified the song of the Least Chipmunk.

On July 21, 1914, at Ypsilanti, Mich., I met Dr. Max M. Peet, who knew the species well, and assured me that its song is much like that of the junco—a prolonged twitter.

Its other notes bear much resemblance to those of the Eastern Chipmunk.

REFERENCES

1918—Wild Animals of North America, by E. W. Nelson, pp. 552-53-56.
1922—Diagnoses of Seven New Chipmunks of the Genus Eutamias, with a List of the American Species, by Arthur H. Howell, Journ. Mamm., Aug., pp. 178–85.
1925—Preliminary Description of Five New Chipmunks from North America, by Arthur H. Howell, Journ. Mamm., Feb., pp. 51–54.

---

[20] Preble, N. A. F., 27, 1908, p. 168.

LIFE LXXII—THE EASTERN CHIPMUNK

PAGE
Names 184
Description: Size, Colour 184
Races 185
Range 185
Haunts and Home Range 187
A Creature of the Day 188
A Stay-at-Home 188
Numbers 189
Chinisa's Citadel 191
Home Love 192
Replenishing the Woods 192
The Stripe-lings 194
Sociability 195
Enemies 196
In Peril 197
Insect Pests 198
Food Habits 198
As Flesh and Insect Eater 199
A Small Tiger 200
His Savings Bank 201
His Pockets 202
His Banking Methods 204
A Perverted Instinct 206
The Song from the Stump 206
An Appreciative Audience 208
Hail to the Spring 208
His Kalendar 210
His Way of Life 211
Aloft and Afloat 212
The Winter Sleep 212
Autumn Joy 214

References 215

Common Chipmunk, Big or Eastern Chipmunk, Chipmuck, Chipmuk, Chipping Squirrel, Mouse-squirrill, Striped Ground-squirrel, Chippie, Hackee, or Hackey

Tamias striatus (Linnæus)

(Gr. *tamias*, a steward, one who stores and looks after provisions; L., *striatus*, striped)

[*Sciurus*] *striatus* Linnæus, 1758, Syst. Nat., ed. X, I, p. 64.
Tamias striatus Baird, 1857, 11th Smiths. Rep., p. 55.

Type Locality—Southeastern U. S., probably Virginia

French Canadian, *le Suisse.*
Cree and Ojibway, *Ah-gwin-gwis.*
Sauteaux and Muskego, *Ah-ging-goos.*
Yankton Sioux, *Ah-tah-chah.*
Ogallala Sioux, *Hayt-kah-lah.*
Choctaw, *Chinisa* (Byington)

The genus *Tamias* (Illiger, 1811) comprises small Squirrels, living on the ground. They have well-developed cheek-pouches; and along the back, a series of black stripes on their brown or gray fur.

The teeth are:

$$\text{Inc. } \frac{1-1}{1-1}; \text{ prem. } \frac{1-1}{1-1}; \text{ mol. } \frac{3-3}{3-3} = 20$$

In its native surroundings, its black stripes, rich colours, and lively habits identify it easily.

In addition to the generic characters, the Common or Eastern Chipmunk has the following:

Size. Length, about $9\frac{1}{2}$ in. (241 mm.); tail, $3\frac{1}{4}$ in. (82 mm.); hind foot, $1\frac{3}{8}$ in. (35 mm.).

Colour. On the nape, shoulders, back, and upper surface of the tail, it is a dark pepper-and-salt, tinged with chestnut on the head, and changing to clear orange-brown on rump, thighs, and root of tail. On its back, it has five stripes, which are so deep a brown as to pass for black. The central one, the thinnest, beginning at the crown, between the ears, as a deep chestnut, becomes black just behind the shoulders, and fades in the pale chestnut of the rump; the other four are in pairs on either side, from shoulder to hip, separated by a strip of pale buffy white. The eye is in a dark streak, with a whitish streak above and another below. The cheek is fawn colour with a dark streak across it, and fades into white on the throat.

The flanks generally, the feet, and under side of the tail are pale fawn colour; inner side of legs and all below, pure white. The tail has a black fringe or border with white tipping.

The female is similar.

So far as I know, neither albinos nor melanos have been recorded for the species.

RACES

The five races may be briefly characterized thus:

striatus Linn., the typical form, with a general chestnut tinge, especially on the flanks. T. l., Southeastern U. S.

griseus Mearns, a larger, paler, and grayer form. T. l., Ft. Snelling, Minn.

lysteri Rich., like *striatus*, but larger and paler, with rump and thighs yellowish red, instead of chestnut. T. l., Penetanguishene, Ont.

venustus Bangs, a large bright-coloured form, with shortened stripes. T. l., Stillwell, Okla.

fisheri Howell, smaller than *griseus*, much paler and grayer than *striatus*. T. l., Ossining, N. Y.

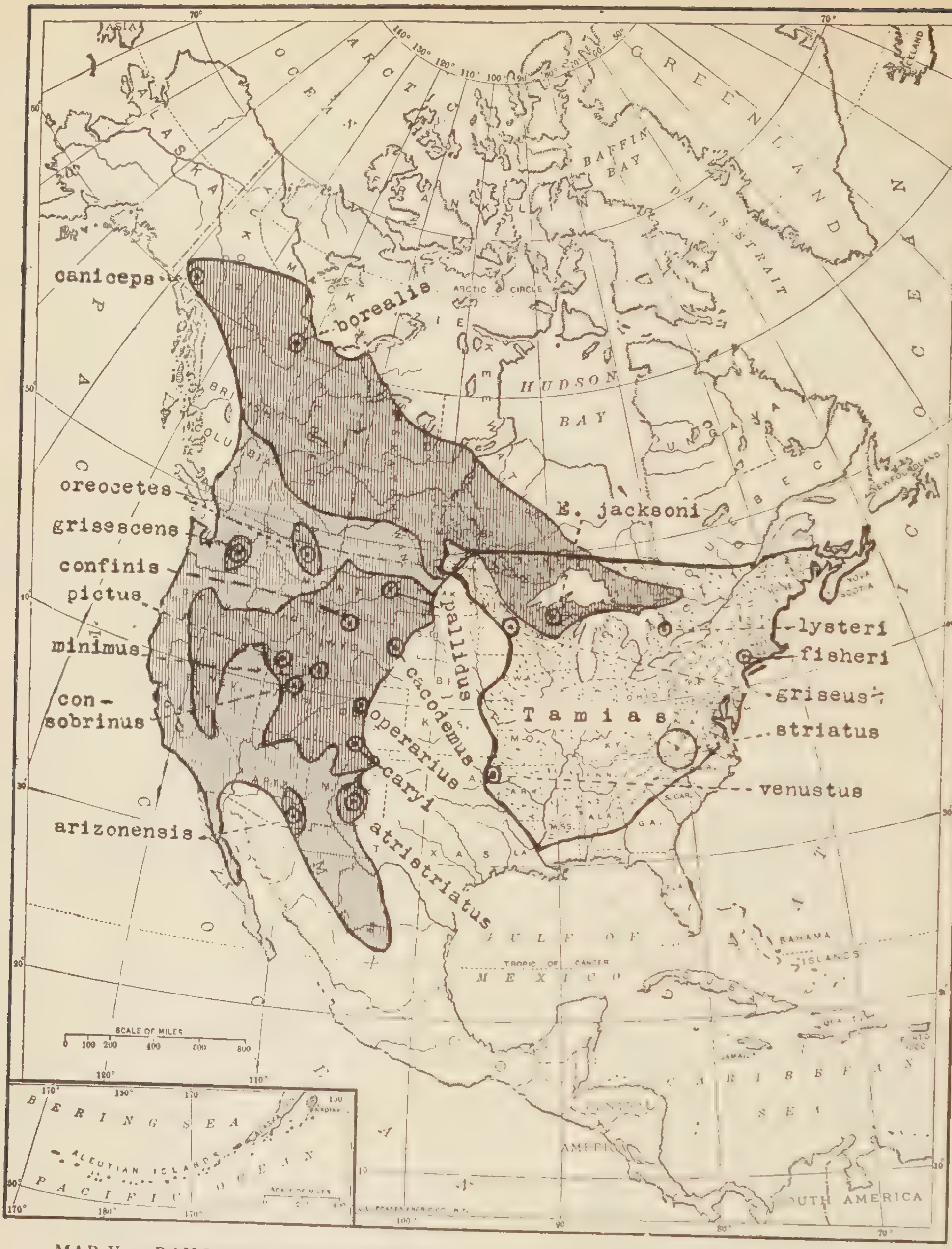
RANGE

The range of this species covers the Carolinian and Alleghanian Faunas, and the south edge of the Canadian east of the ever-significant 100th meridian. In the North, its range is nearly that of the beech, big-toothed poplar, black cherry, etc.; in the South, of the chestnut, shagbark, butternut, etc. Its range at all points nearly coincides with that of red oak, blueberry, dogwood, etc.

Its distribution in Canada is that of an Eastern species that is spreading northwestward. It is abundant about Ingolf, Ont.; also, I am told, at Kenora, Ont. Dr. Elliot Coues collected 4 specimens at Pembina;[1] and I found it plentiful along the Red River down at least to lower Fort Garry. I have a specimen taken at Morden, Man., by D. Nicholson, who tells me that it is not rare there.

---

[1] Monograph N. A. Rodentia, 1877, p. 789.



MAP V.—RANGE OF THE EASTERN CHIPMUNK, AND OF THE LEAST CHIPMUNK

By E. T. Seton, with assistance of the Biological Survey, 1927

The range of the Eastern Chipmunk or *Tamias* is dotted and enclosed in a heavy line.

The range of the genus *Eutamias* is all of the tinted area with the Ottawa River as its easternmost point.

The range of the Least Chipmunk *minimus* and its races is in dark tint.

I have seen several specimens that were taken at Portage la Prairie, Man., where it is common. I found it ranging west of Portage la Prairie for about 20 miles, but never got it at Carberry, Man. On the west side of Turtle Mountain, Vernon Bailey found it common in Aug., 1887.[2]

Northwesterly, following the line of the old lake shore from Morden, I traced it up to Dauphin, Man., where it seems to be abundant. J. J. G. Rosser tells me that it is plentiful at Winnipegosis, and on all high ground of Red Deer Point. This represents its northwestern limit, as at present known. In Manitoba, I have never found it beyond the old Agassiz Lake bed.

HAUNTS AND HOME RANGE

Log-heaps, stone-piles, broken rocky ridges, wooded banks, and ramshackle outbuildings, in dry, sunny places near woodlands, are the chosen places of the Chipmunk. We look for it in vain on open prairie, in gloomy, unbroken forests, or in swamps. Sun, food, and a dry, sheltering labyrinth near the ground are the essentials of Chipmunk happiness.

Though but slightly arboreal, it is at home in the woods, and is usually very local in distribution. A great many will gather at some very attractive spot, while the region around, though appearing to answer their needs, may be without Chipmunks.

The home range of each individual is undoubtedly very small. On one occasion in late June, I followed two Chipmunks that left the hole together, and set out as though with an object. They travelled to a small knoll covered with oaks, some fifty paces away. At another time (June 15, 1905) I saw a Chipmunk make repeated journeys between a small grain storehouse and his den, about fifty yards away, down hill, through the woods. Both these cases were at Cos Cob, Conn.

In order to mark an individual Chipmunk for better observation in this regard, I caught a female that lived by our porch. Then I placed the cage-trap that held her in a bowl of deep blue-purple dye. The Chipmunk did not like it at first, and splashed in such vigorous protest that everything within three feet looked very blue. But she found it not so bad as it looked, and soon was sitting contentedly with only her head above the purple sea. To help her pass the time, and evidence my good feeling, I offered some bread. This she accepted in a proper spirit, and fell to eating; but held it so low that it was speedily dyed an intense purple, which, however, apparently detracted nothing from her relish.

---

[2] Rep. Orn. & Mamm., Dept. Agri., 1888, p. 437.

When taken out and dried in the sun, her back colour was hardly changed, but her breast, throat, and feet were of a most distinctive imperial hue. I took her to the woods to a place about 150 yards from her home, and set her at liberty. This was July 14th.

All that summer, a Chipmunk frequented our porch, though I never saw it in clear light close at hand. On Sept. 25th, I saw one there singing its full song. A cage-trap quickly brought it within reach, and I learned that it was my purple Chipmunk, though there was not a trace of the dye excepting on the bare skin of nose and feet; these were yet of a bright blue.

This and the opinions of other naturalists comprise all the evidence I have on the home range of the individual Chipmunk; and it leads me to believe that, though the animal may go 100 or 200 yards away on occasion, it ordinarily spends its entire life within the narrow compass of an acre.

A Creature of the Day

A further limitation the Chipmunk imposes on his life by his strictly diurnal habit. At most, he is active after sundown only in the busy season—that is, harvest; and even then, retires long before dusk. Like the sundial, he responds only to the shining hours.

Audubon depicts the barn owl—most nocturnal of its tribe—with a Chipmunk in its claws; doubtless he had some good reason for this, but I do not know what it was.

A Stay-at-Home

So far as I have seen, the species does nothing in the way of migration. Dr. Merriam, on the other hand, states his belief that the Adirondack Chipmunks *are* migratory.

In June, he says, "the species attains its maximum in numbers, the young and old together inhabiting all parts of the woodland. Foreseeing that the nut crop will fail (this being the even year), they commonly emigrate in July and do not again appear till September or October of the ensuing year.

"Briefly, then (leaving out of consideration the small number of resident individuals, and the migrants that sometimes pass through on their way to distant parts), we find Chipmunks reach the Adirondack region during September or October of the odd years (nut years), remaining till the following July. They then depart and are not seen again till the autumn of the next year. Hence they are here about ten months, and absent about fourteen months, the period of greatest abundance being in June of the even years (when there are no nuts)."[3]

So also in the summer of 1908, John Burroughs wrote me that the Chipmunks appeared at Roxbury, N. Y., in extraordinary numbers.

Yet I do not find in these observations *conclusive* proof that the species is migratory. I cannot learn that any one ever *saw* a migration of Chipmunks, which is an essential of the case.

My own views are sustained by William Brewster of Concord, Mass. In 1908, I wrote him, asking whether he had seen any evidence to prove migration in the Chipmunk. He replied May 9, 1908: "None whatever. As to the theory of migration, I am decidedly sceptical. All my observations on the habits of this Chipmunk have led me to believe that it is a very sedentary creature, never given to extensive wandering at any season."

At Cos Cob, Conn., the Chipmunks had abounded up to the autumn of 1907. The nut crop was a failure that year. In the spring of 1908, a melancholy change had come over the woods. There was no spring chorus, and only three Chipmunks were discovered after a thorough investigation covering weeks. All three were at places where they could live on corn put out for the ducks. In June, however, there seemed to be a slight increase in the number of adult Chipmunks, which added another perplexity to the problem.

When autumn came, the ground was pebbled over with hundreds of bushels of acorns, chestnuts, and hickory nuts, but there were no Chipmunk hordes. There seemed to be a slight increase in their number, but less than reproduction would have explained. Four times in the third week of October, did I hear a solitary Chipmunk strive to raise the chorus as he perched on some stump; but in each case there was but one voice. The merry host of a year before was no longer in the woods.

I am inclined to think that the explanation of the variant number of Chipmunks in the Adirondacks during nut years, is that the plentiful food supply permits actual increase, and in famine years they die. They *seem* most abundant in June of the nutless years, because the scarcity of food compels them to be out and stirring all the time, and so they are much in evidence.

The only migration I have seen among them is like that of the flowers—the summer, above ground; the winter, below.

NUMBERS

The greatest abundance of this species that I ever saw in the Northwest was at Ingolf, which is on the Canadian Pacific Railway, just east of the

---

[3] Mamm. Adir., pp. 234-35.

Manitoban line. During a visit there in 1904, I found both this species and *Eutamias neglectus* in numbers about the railroad siding. Here long lines of grain cars, jolted at start or stop, had made the place a delectable forage ground for the ever-growing hordes of Chipmunks, that found, further, an ideal residence in the tumbled rocks composing the railroad dump. Among these they had excavated, or located, endless labyrinths which doubtless afforded them security from most of their enemies.

The railway is an important agent in the distribution of several animals; forming, as it does, a plain, sunny opening in the forest, a continuous sheltering bank on the prairie, a means of crossing rivers, and a long chain of food supplies in the waste from grain cars.

During the two days at Ingolf, I saw perhaps 25 of the large species, but the residents told me that they were now far from their usual number; on warm days earlier in the month, ten times as many might have been seen. Already (Sept. 16th), apparently, some of them had retired for the season.

Along the wooded shores of the Red River and Assiniboine River, the tangled brushy banks afford to the Chipmunks good concealment, as well as plenty of nut and seed supplies. Here, though they were less abundant than at Ingolf, I found them so generally distributed that it would be safe to estimate their numbers at a pair for every 50 yards along the river front.

Writing of the species in New England, John Josselyn says (1675) that they "are notable nut gatherers in August; when hasel and filbert nuts are ripe, you may see upon every Nut-tree as many Mouse-squirrils as leaves; So that the nuts are gone in a trice, which they convey to their Dray or Nests."[4]

At Cos Cob, Conn., the species abounds, doubtless as in primitive times, even though not "as numerous as leaves." Along the drive which passes through the woods for 700 yards, I found 7, or perhaps 8 pairs. This would give about 1 pair to each acre. A favourite hollow just back of the house, however, has as many as the entire drive, although it is less than half an acre in extent.

At my Greenwich, Conn., home in 1926, there were certainly 20 or 30 on the acre about the house; but that is an exceptionally favoured place.

One pair to the acre is over 1,000 Chipmunks to the square mile; and this, I should say, is well within their numbers in all the half-cultivated parts of their range in years of abundance. But in places of high cultivation —like Ohio and southwestern Manitoba—or of no cultivation at all—like northern Ontario and northeastern Manitoba—I should divide the figures by 100. On this basis, I should reckon up the Chipmunk population of their entire range at not less than 20,000,000 in years of abundance; and in years of disaster, reduce it to a quarter as many.

---

[4] Two Voyages to New England, Boston Reprint, p. 69.

Chinisa's Citadel

Circumstantial evidence and analogy made clear long ago how the Chipmunk forms his burrow, without showing an earth pile at the door. Near the selected spot, he digs down, exactly as do other burrowing animals, scratching loose the earth with front feet, and pushing it out backwards with hind feet. Never is he known to convey earth in his cheek-pouches; they are strictly food pockets.

He repeats this process till the burrow is big enough, and the excavated earth in a vast and visible pile at the door of commencement. Now, many feet away, a new door is made from the inside, so neat and small, so wholly without earth dump or lead-up, that a clover leaf may conceal it. Finally, the original entry of the excavation is plugged up. Kind nature scatters the pile, or grasses it over. Thus, the Chipmunk has a tunnel without a dump.

That this is his method, I was many years ago convinced. Then, John Burroughs wrote me, Oct. 11, 1920, that he had seen the performance, and found it as above. Finally, in the July of 1926, on a bank at my home, I myself was privileged to witness the entire process.

A nest which I dug out on my land in Greenwich, May 9, 1925, was under two flat rocks among the vast and far-flung clutching roots of half a dozen ancient hickories. The labyrinth of the burrow was too complex and rootbound for exact mapping. It seemed to cover a space 15 or 20 feet square, and had many entries. The nest was 2½ feet down, and measured 12 by 18 inches, by 6 or 8 inches deep; and was warmly lined with dry leaves. The calibre of the burrow leading to it was 1½ or 2 inches. The nest contained 150-odd hickory nuts (shagbark), 1 pint of oats (stolen), 1 pint of seeds (basswood), and a midden heap of empty shells that was 6 by 8 inches by 4 inches deep; showing that these are devoured when the Chipmunks are living underground. (See Plate XIX, p. 209.)

A den opened by Kennicott in November was found to have for storage "four or five enlarged chambers, in different parts of the burrow, which was complicated, and consisted of several winding and intersecting passages situated not over a foot below the surface. The entrance to the burrow was under a log, and the passages extended several feet on every side. A large nest of leaves and grass was placed above the surface, under the rotten log."[5]

---

[5] Quads. Ill., p. 72.

Home Love

A curious instance of pertinacity on the part of the species took place at my home at Cos Cob, Conn. A Chipmunk had decided to make a doorway in the middle of the drive. Accordingly, the tunnel appeared, bored from below. I filled it up with coarse gravel, and packed it tight for at least a foot down into the burrow. Two days later, it was reopened *from below*. Again it was rammed full of hard gravel—to be opened again, and within forty-eight hours. Sixteen times during one month did I stop up this hole, and as often it was reopened from below. What became of the bushels of gravel I could not find out, but a general depression at that part of the drive began to show. At the end of five weeks' struggle, I went away from home, for a rest, the Chipmunk triumphantly completing his earthworks.

That was in 1903, and he held it peacefully throughout 1904. In 1905, I renewed the contest. For thirty successive days in the month of May, I closed the hole once, or sometimes twice, a day, and as often it was opened from below. Twice only was it opened from without; and in each case, I saw the animal outside when I closed the hole. From this, I argue that he had but one doorway; and whatever he did with the earth, it was not brought out of that doorway. Possibly, in this case, it was stowed in some rock cranny under the drive, which was founded on large stones.

In July, though no longer persecuted, this Chipmunk abandoned the hole, perhaps because of the various annoyances; though it must be remembered that July is the season when all the Chipmunks, as we shall see, seem to disappear. In August, he reopened this den, and dwelt there till snowfall said "bedtime."

In 1906, I again renewed the battle, but desisted at the end of summer. That Chipmunk held the fort in Sept., 1906; and had the satisfaction of giving a jolt to every carriage that too rudely passed his door.

The species is known to be wonderfully tenacious of its holdings. Where you find a Chipmunk this year, you are likely to find one next year, probably the same Chipmunk. This is in marked contrast with the habit of the Woodchuck.

Replenishing the Woods

There is much doubt about the exact mating time of the Chipmunks. Unquestionably, they have a season of excitement during the autumn; Rhoads thinks[6] that this may be the mating season. The Tree- and Flying-squirrels are known to mate in late autumn or early winter, according to latitude. I certainly saw the small Chipmunk of the High Sierra rutting in late September. Then, again, the Chipmunk of the Northern States will come out, like the proverbial Woodchuck, in February, and race about like mad. This Seth Nelson thinks[7] may be their rut.

---

[6] Mamm. Penn. & N. J., p. 62.

But these same evidences are found in greater degree during the excitement of the early spring, with the additional proof that the sexual organs are then in a high state of functional activity. The visiting Chipmunks described by Burroughs (quoted later) may have been seeking mates. On May 5, 1906, a male Chipmunk, caught for examination at Cos Cob, showed by the condition of the organs that this was its season of procreation. On May 31, 1926, Dr. Clyde Fisher saw a pair of Chipmunks copulating on the terrace of my home at Greenwich.

On May 6, 1906, I found at Cos Cob, dead in a Rat trap, a female, apparently a week or ten days after the birth of her brood. Another female, caught that day for examination, was obviously at the point of becoming a mother.

As early as May 21st, at Cos Cob, the young, already half-grown, have been seen; and on Sept. 27, 1906, I saw two, about half-grown, follow an old one for some 50 feet from the den. On Oct. 8th, I caught for examination a female that was, or recently had been, suckling young. On Oct. 14th, I saw a half-grown Chipmunk playing about the door of its parental home.

In Pennsylvania, during late October, S. N. Rhoads collected some two-thirds grown Chipmunks that could not have been born much earlier than late July.[8]

How are we to reconcile all this conflicting testimony? Is it not possible that the species has several ruts in the year, and those females that are impregnated in the fall have a protracted gestation, as has been observed in certain other mammals that hibernate? It seems probable at least that two broods are produced each year.

Nevertheless, the principal season of sexual ardour is early spring. Though the others are open to question, there can be no doubt concerning the springtime revel. So that, beginning with the general awakening, the first month of their vernal life is given up to love, music, and feasting.

Food is now scarce everywhere, there is snow in the woods, there may even be more snowstorms; and the Chipmunks' joy might end in disaster, had they not provided against the possibility of evil days. It was for this merry time of carnival that the abundant supplies were laid up the year before. During a month or more, their chief dependence will be this garnered product of the year gone by.

---

[7] Mamm. Penn. & N. J., p. 62.

[8] As above.

Whether they pair or not, I cannot say; most naturalists believe that they do. I have usually found two old Chipmunks in each hole, except when the young were very small; then the mother alone is seen about.

The time of gestation, judging from analogy, should be about a month; but I have no direct evidence, and the blank time of hibernation might greatly prolong the period in those females that were newly pregnant when entering on their winter sleep.

Rhoads thinks[9] "it is not unlikely that the female Chipmunk, during parturition, and for some time after the birth of her young, does not leave the burrow, but either lives on the food she has stored there, or is fed by her male partner."

The following note bears on their habits at this season: On May 29, 1905, I caught the Chipmunk that lived in the bank west of the house. It proved to be a female; she had the usual 8 teats, but only 4 "in commission." I caught her again that afternoon in the same place. Each time on being released, she took refuge in a hole remote from the nest hole, once 25 feet away, once 50 feet away. I never saw more than one grown-up about this hole.

The Stripe-lings

The young number 4 or 5; and are, as usual with the group, blind, helpless, naked, and almost shapeless, little pink pillules of vitality. As soon as their coats appear, they show the adult markings. Unlike Cougars, Wild Boars, etc., they have no peculiar livery for infancy—a livery that is supposed to be reminiscent of remote ancestors.

So far as I know, the female alone cares for the young. By mid-May in Connecticut, they are sufficiently grown to venture outdoors; and when half grown, they will follow the mother 40 or 50 feet from home.

The following notes by Dr. T. J. Henry, of Apollo, Pa., form an important contribution to the subject:

"Early in July, 1906," he says, "an old Squirrel [Ground-squirrel or Chipmunk] was caught and caged as a pet for the children. Shortly afterwards, she was noticed making a nest with much more care than is usually exhibited by them in captivity. The cage was simply a box with wire screen in front and no nesting box. The nest was made of dried grass and paper, and the central portion was of very finely divided pieces.

"On July 17, a small squeaking sound announced the presence of a new life. On inspection, this tiny bit of pink Squirrel life was found to be 'the size of a peanut goody' as one of the children expressed it.

---

[9] Mamm. Penn. & N. J., p. 62.

"In the skin could be seen the pigmented stripes indicating the position of the future black hairs. It is remarkable that though it squeaked when disturbed the first two days, thereafter it remained absolutely quiet when handled, until over a month old.

"On July 28, 11 days old, it measured 3 inches from tip to tip, was ill-shaped, hairless, blind. Its head was larger than its body. Very slight noticeable growth of hair started at this time.

"By August 6, the hair covered its head sufficiently to give it a velvety appearance. Two days later, it extended over its body, giving natural colour to the Squirrel. Its tail, however, was rat-like.

"August 12, it measured 4 inches from tip to tip. . . .

"August 19, it squeaked and struggled when taken from the nest. This was the first sound I had heard it emit since it was 2 days old.

"August 20, 35 days old, its eyes opened for the first, a much longer time than is required for Kittens, Rabbits, etc.

"After August 23, its tail became distinctly bushy. It was shy, and avoided being handled, but made no attempt to bite. August 25, it was found running about in its cage, and appeared almost half grown."[10]

By the end of August, most of the young Chipmunks are fully grown, and able to shift for themselves. Possibly the 3 or 4 individuals often found in the winter den are the family of that year.

Testimony in point is given by Rhoads who says: "That many Chipmunks enter and appear to be at home in the same burrow in the late fall, is evidenced by my having trapped at the mouth of a single burrow, between the 15th and 25th of October, on the mountain three miles above Round Island, Clinton Co., Pa., 7 full-grown Chipmunks, of which 1 was an adult female, 1 an adult male, 1 a young female, and 4 young males. Three of the young males and the young female were so nearly alike in size that I think them the offspring of the old pair, and that it was likely they all were expecting to hibernate . . . in this retreat."[11]

SOCIABILITY

The species is quite sociable as well as gregarious. Not only do Chipmunks associate in numbers where the surroundings are attractive; but they unite in several efforts, notably the spring chorus described later; and, as

---

[10] Guide to Nature, Jan., 1909, pp. 364–65.

[11] Mamm. Penn. & N. J., pp. 62–63.

Kennicott remarks, "sometimes, though not always, several pairs occupy the same burrow in winter, the store of food being common property."[12]

Some interesting observations on their sociability are thus supplied by John Burroughs: "One March morning," he says, "after a light fall of snow, I saw where one had come up out of his hole, which was in the side of our path to the vineyard, and after a moment's survey of the surroundings, had started off on his travels. I followed the track to see where he had gone. He had passed through my woodpile, then under the beehives, then around the study and under some spruces, and along the slope to the hole of a friend of his, about 60 yards from his own. Apparently, he had gone in here, and then his friend had come forth with him, for there were two tracks leading from this doorway. I followed them to a third humble entrance, not far off, where the tracks were so numerous that I lost the trail. It was pleasing to see the evidence of their morning sociability written there upon the new snow."[13]

This seems to imply strong social instincts; and yet I have never seen two Chipmunks at rest close enough to be in the same photograph

ENEMIES

Among the Chipmunk's enemies are Cats, Foxes, Weasels, hawks, and snakes; but the smaller Weasels are probably the most destructive of its foes. It has only one means of escape from these bloodthirsty little fiends; and that is, to retreat into a side gallery of the burrow, and then plug with earth the passage behind it. I never saw this done, but I have often found the burrows of small rodents so plugged when I was after them. I am satisfied that it was done by themselves, and that it is a deliberate attempt to baffle an enemy by slamming the door in his face. It is very certain that, if not foiled by some such expedient, a Weasel, on entering the labyrinth of a colony, could easily follow his bent—hunting down and killing every member of the community before he moved to fresh fields of carnage.

That the Weasel does so at times is attested by the following from the pen of Bachman:[14]

"We once observed one pursue a Chipping Squirrel into its burrow; after an interval of ten minutes, it reappeared, licking its mouth, and stroking its fur with its head by the aid of its long neck. We watched it as it pursued its way through a buckwheat field, in which many roots and stumps were yet remaining, evidently in quest of additional victims. On the following day, we were impelled by curiosity to open the burrow we had seen it enter. There we found an old female Ground-squirrel and five young, half grown, lying dead, with the marks of the Weasel's teeth in their skulls."

---

[12] Quads. Ill., p. 72.

[13] Squirrels and Other Fur-bearers, 1900, pp. 23–24.

[14] Q. N. A., I, p. 72.

I suppose we must add the Red-squirrel to the list of the Chipmunk's enemies; for on Nov. 4, 1922, I saw a Chickaree with murder in his eye, hotly pursuing a Chipmunk, which, however, eluded him by diving into the home-burrow.

Many naturalists credit the Chipmunk with killing and eating frogs. But a surprising turn of the tables is seen in the following, which relates the killing of a Chipmunk by a bull-frog. It is from the pen of Robert B. Symington, of Massachusetts. He, with a friend, was walking by a trout pond on his preserve, when, he says: "We noticed a Chipmunk on the narrow path ahead of us. It left the path as we approached, and jumped from stone to stone near the water. It took one jump too many, for a large frog caught it instantly, and we could plainly see it holding the Chipmunk until it was drowned, when the frog slowly swallowed it. Leaving my friend to watch, I cut a stick, and in ten or more minutes, I should think, it came to the surface, when I knocked it on the head. All that remained visible of the Chipmunk was half an inch of its tail."[15]

In Peril

The Rev. E. R. Kildon, of Loyal, Wis., sends me the following. It closely parallels my own experiences with Snowshoe Rabbit and Antelope. "For quite a while," he says, "a Chipmunk has been making his home on the parsonage grounds. I saw a Cat catch him one morning. She came carrying him toward the house, by the hips, and laid him down to get a better hold. I drove her away, and saw to it that he was safe. This morning another Cat came bringing him in. I went out, and on my coming, the Cat laid him down. When I came up, he hobbled over to me, crawled over my foot, crawled up the back of my leg; and when the Cat walked round in search of him, he went clear to the top of my head, and sat there until I had one of the boys take the Cat into the house. Then, as I stooped down, the little fellow jumped to the ground, and made off.

"I am a lover of the wilds and wild things, and there must have been an instinctive feeling of protection from me in the Chipmunk."[16]

---

[15] Forest & Stream, April 20, 1907, p. 612.

[16] Personal letter, July 31, 1912.

INSECT PESTS

The cuterebra or warble-bot does not spare the Chipmunk. Dr. Merriam writes:[17] "The most extraordinary instance of the prevalence of this disgusting parasite that has fallen under my observation, was at the south end of Lake Champlain, N. Y., in October, 1885. On the 7th and 9th of that month, I killed more than 50 Chipmunks (*Tamias striatus lysteri*) within a few miles of old Fort Ticonderoga, and on the rocky side hill behind the town of Whitehall. Of these, a very large percentage—I think fully one half—were infested with 'wabbles' (*Cuterebræ*). More females than males were thus afflicted. The 'wabbles' were usually situated near the median line, and anywhere from the umbilical region to the genitals. In a few cases, they were in the axilla; and in one or two instances, in the upper part of the foreleg. In a number of individuals, two *Cuterebræ*, were found; and in a few cases, as many as three.

"Dr. A. K. Fisher tells me that he collected a number of Chipmunks about the south end of Lake George, Warren Co., N. Y., during the latter part of August and first of September, 1882, a considerable proportion of which were infested with *Cuterebræ*. As many as three were found, in different stages of development, in one animal."

Dr. E. A. Mearns writes concerning the Chipmunk of the Catskills: "More than one half were afflicted by a subcutaneous parasite (*Cuterebra*) embedded in the cervical, abdominal, or inguinal region."[18]

FOOD HABITS

The food of the Chipmunk is chiefly seeds, berries, and nuts; but insects, flesh, and birds' eggs also enter into its summer bill of fare.

Kennicott says:[19] "Like the true Squirrels, the Chipmucks are properly nut-eaters, though they feed rather more on the seeds of small plants than their arboreal relatives; nor do they subsist upon the buds of trees."

Mearns says of the Catskill Chipmunks (*lysteri*): "The specimens collected had fed most extensively upon mushrooms, wild cherries, and a small bulbous plant, probably a sedge."[20]

George H. Measham, of Winnipeg, wrote me in 1906, that on the north shore of Lake Superior, he saw a Chipmunk having a riotous feast on ras-berries.

---

[17] Insect Life, I, p. 215.

[18] Mamm. Catskill Mts., Proc. U. S. Nat. Mus., XXI, 1899, p. 352.

[19] Quads. Ill., p. 71.

[20] Mamm. Catskills, p. 352.

PLATE XX. -TWO PHOTOGRAPHS OF SINGING CHIPMUNK SURROUNDED BY ENGLISH SPARROWS

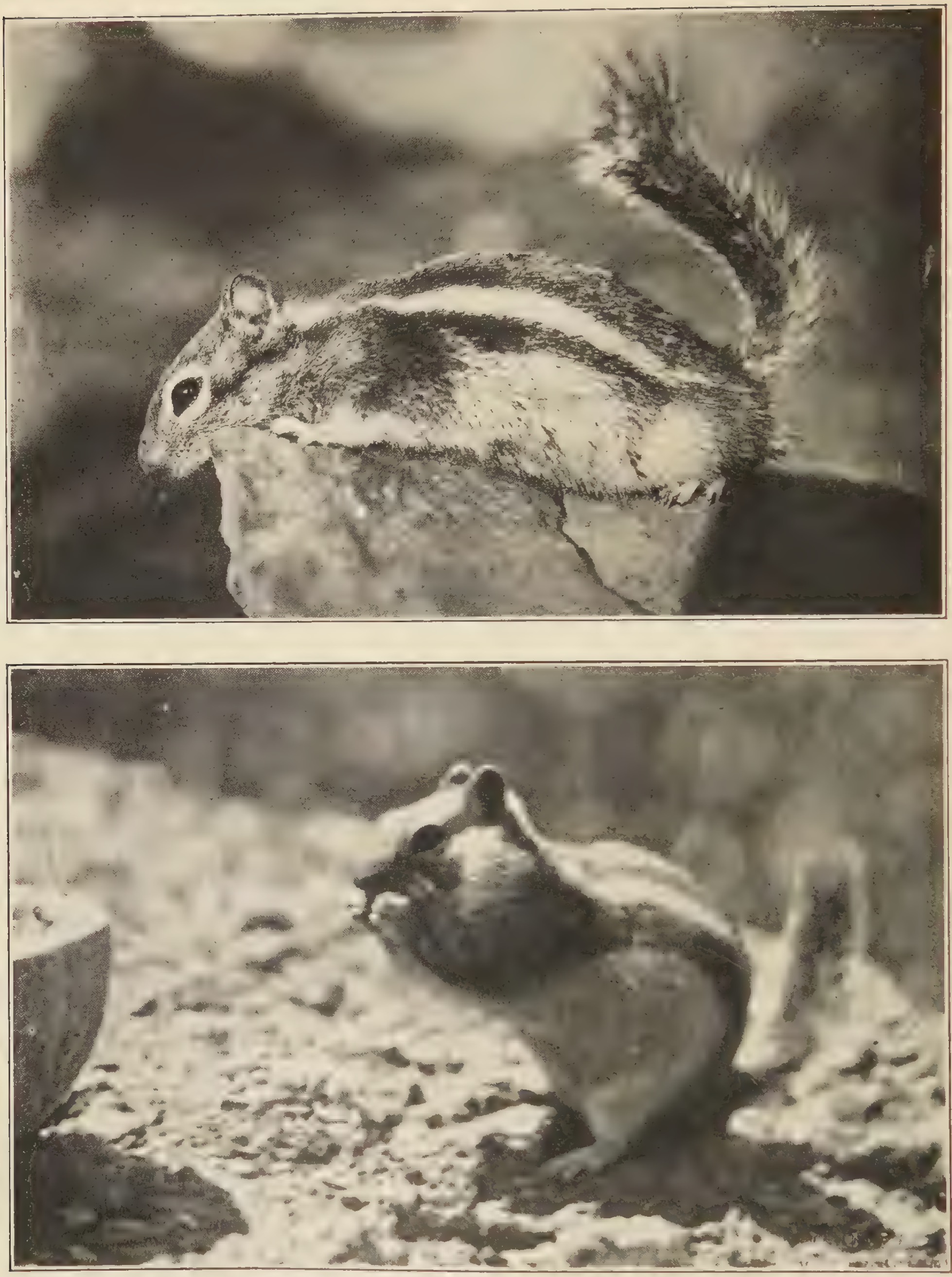


PLATE XXI.—PHOTOGRAPHS OF SAY'S CHIPMUNK

The upper by W. E. Carlin; the lower by H. L. Standley, of Colorado Springs, Colo.

Prof. A. Brooker Klugh says of his half-tame wild Chipmunk: "I offered her various foods, and she refused meat and sweet substances, but accepted seeds, fruits and tubers. By far her favourite item was corn—either raw or boiled. Of this she sometimes ate a kernel or two, but carried most of it away in her cheek-pouches. In loading up her pouches, she placed the kernels alternately first in one pouch, then in the other, and when they were nearly full, she shoved the last few kernels in with one of her forepaws. A full load, as tested several times, consisted of 31 large kernels—equal to two heaped-up tablespoons. I saw her drink once, and upon this occasion, I could not commend her choice, unless 'internal bathing' was the result sought, as she lapped up some soapy water from the hand-basin."[21]

And again: "These Chipmunks were gathering hazel-nuts (*Corylus rostrata*), climbing the shrubs, cutting off the nuts and carrying them away. They did not waste any time cutting off bad nuts, as all the nuts left on the bushes after the Chipmunks had visited them, proved on examination to be bad."[22]

As Flesh- and Insect-eater

Several naturalists have testified that the Chipmunk does not confine itself to vegetable diet.

W. T. Davis, of New Brighton, Staten Island, N. Y., writes: "On the 29th of June some years ago, I saw a Chipmunk catch a moth. pull off its wings, and eat it."[23]

Roger H. Motten, Executive Secretary of the Woodcraft League of America, tells me that on Aug. 23, 1926, at Bear Mountain, near New York City, he saw a Chipmunk kill and devour a large insect, apparently a grasshopper. And the other day, I saw one lugging what looked like a bunch of grasshoppers.

A. J. Cook, of Lansing, Mich., states that a Chipmunk was observed nibbling at a snake that had been recently killed. He could hardly be driven away, and soon returned to his feast when his tormentors had withdrawn to a short distance.[24]

In the *Guide to Nature* for Feb., 1919, p. 234, the editor gives several cases of a Chipmunk feeding on frogs. In the section on Enemies herein, (p. 197) is a case in which the Chipmunk was the victim of the frog.

On July 12, 1926, Miss Hannah Engstrom, of Greenwich, Conn., saw a Chipmunk run into my cellar carrying a Mouse in its teeth.

---

[21] Journ. Mamm., Feb., 1923, p. 30.

[22] As above, p. 31.

[23] Forest & Stream, Feb. 9, 1907, p. 214.

[24] Amer. Nat., March, 1870, p. 58.

On Nov. 12, 1925, my gardener, Tom Glennon, reported that he saw a Chipmunk capture and eat a very small Mouse in the garage.

Caroline M. Hartwell, of Spring Valley, N. Y., describes at length the killing of four young bluebirds by a Chipmunk.[25]

In his paper on the "Birds of Coldstream," Ont., A. A. Wood says: "Last spring (June 8, 1918) I noticed a Red-eye excited over something, then saw a Chipmonk, climbing the sapling the bird was in. When he was about 8 feet up, the vireo darted down, knocking him to the ground. The other bird was on the nest at the end of one of the branches. The nest contained four cowbird's eggs, and one of their own, so little was gained in keeping the Chipmonk away."[26]

A Small Tiger

A still more remarkable incident is recorded by Alexander Wilson, the ornithologist.[27] It shows that the Chipmunk is as omnivorous as any of its omnivorous tribe; and can, on occasion, play the part of a little Tiger in its own small world.

"My venerable friend, Mr. William Bartram," he says, "informs me that he saw one of these birds [spotted sandpiper] defend her young for a considerable time from the repeated attacks of a Ground-squirrel. The scene of action was the river shore. The parent had thrown herself with her two young behind her, between them and the land; and at every attempt of the Squirrel to seize them by a circuitous sweep, raised both her wings in an almost perpendicular position, assuming the most formidable appearance she was capable of; and rushed forward on the Squirrel, who, intimidated by her boldness of manner, instantly retreated; but presently returning, was met as before, in front and on flank, by the daring and affectionate bird, who, with her wings and whole plumage bristling up, seemed swelled to twice her usual size.

"The young crowded together behind her, apparently sensible of their perilous situation, moving backward and forward as she advanced or retreated. This interesting scene lasted for at least ten minutes; the strength of the poor parent began evidently to flag, and the attacks of the Squirrel became more daring and frequent; when my good friend, like one of those celestial agents, who, in Homer's time, so often decided the palm of victory, stepped forward from his retreat, drove the assailant back to his hole, and rescued the innocent from destruction."

---

[25] Guide to Nature, Jan., 1920, p. 118.

[26] Can. Field Nat., March, 1920, p. 52.

[27] Amer. Orn., 1810, II, pp. 342–43.

Let us hope that this was a Chipmunk of unusual depravity; nevertheless, we can find others of his tribe that are equally abandoned. William Brewster writes me: "While collecting at Crooked Lake, Mich., in May, 1888, I shot at a wood thrush, and broke its wing. As it fluttered off over the ground, a Chipmunk pursued and caught it. When I reached the spot, the Chipmunk had killed the bird, and eaten most of its brains. I had to kick at the Chipmunk to make it give up the thrush. Afterward, as I held the bird dangling in my hand, the Chipmunk approached and jumped up, trying to snatch it from me."

Furthermore, we find in Audubon and Bachman's "Quadrupeds"[28] this paragraph:

"A lady in the vicinity of Boston said to us, 'We had in our garden a nest of young robins (*Turdus migratorius*), and one afternoon as I was walking in the garden, I happened to pass very close to the tree on which the nest was placed; my attention was attracted by a noise which I thought proceeded from it, and on looking up I saw a Ground-squirrel tearing at the nest, and actually devouring one of the young ones. I called to the gardener, who came, accompanied by a Dog, and shook the tree violently, when the animal fell to the earth, and was in an instant secured by the Dog.'"

In the train of this, we are not surprised to find Rhoads's statement[29] that "they not only eat insects, snakes, Mice, birds, eggs, and various species of shelled snails, but have been known to devour each other when wounded or caught in a trap."

HIS SAVINGS BANK

All summer long—May, June, July, August, September, and October—in Connecticut, I have observed the Chipmunks carrying home great bulging cheekfuls of food. Sundry of my notes taken at Cos Cob in 1905 run as follows:

May 28. Chipmunk on bank west of the house, popped into hole with full cheeks, and out again in half a minute with cheeks empty.

June 8. All summer, so far, I have seen the Chipmunks carrying food in their cheeks, and have heard them in full song. I saw an old one at the brook drinking like a little Pig.

June 15. Saw a Chipmunk carrying home two pouchfuls of stuff, from a place over 150 feet away. The young are now out, but rarely with their mother.

Oct. 9. Chipmunks hard at work. Saw one carrying acorns from our lawn down to a place 50 yards away. He made four trips in ten minutes while I watched, and *kept right on*. He took several acorns in his pouches each time, so that his head seemed enormous. It was about I P. M.

---

[28] Q. N. A., I, p. 69.

[29] Mamm. Penn. & N. J., p. 63.

Oct. 27. Chipmunks very numerous, and busy storing food; often singing. These little animals seem to have a premonition of storms, and a dislike to face them. Whenever they were exceptionally busy, we found it meant a falling barometer; and during a three-days' storm, they never appeared, subsisting comfortably, no doubt, on the "hay made while the sun shone."

The name *Tamias* (the steward) was given to this bright little creature because of its admirable foresight in laying up provision for times of storm and scarcity; and it is for this anticipation of the dread season that the Chipmunk is chiefly noted. In the bright, actinic days of autumn, when nuts and acorns are showering down in the groves, the Chipmunk is toiling from sunrise till sunset, to take advantage of the opportunities, filling its granaries to insure itself against starvation that comes stalking through these same woods—and not so very far ahead.

The soundest nuts and seeds are its choice. Never is it known to defile its warehouse with flesh, insects, carrion, or any perishable thing; although it does not hesitate to eat such if they fall in its way while abroad. Its principal stores are hidden in chambers carefully prepared underground in connection with its home den.

His Pockets

The ample cheek-pouches with which the species is provided, enable it to take as much as a dozen hazelnuts to its hole at a single journey. Bachman found[30] that they could carry four hickory nuts at a time, "always biting off the asperities." I learned by experiment on a dead specimen that four acorns of the white oak were as much as each pocket could comfortably hold.

Bachman caught one with no fewer than sixteen chinquapin nuts (*Castanea pumila*) stowed away in its cheek-pouches, and he adds: "We have a specimen now lying before us, sent from Pennsylvania in alcohol, which contains at least one and a half tablespoonfuls of bush trefoil (*Hedysarum cannabinum*) in its widely distended sacks."[31]

As the calibre of the burrow is about two inches, it is not surprising that the Chipmunk often returns home with cheeks so bulging that it must

---

[30] Q. N. A., I, p. 70.

[31] As above, p. 69.

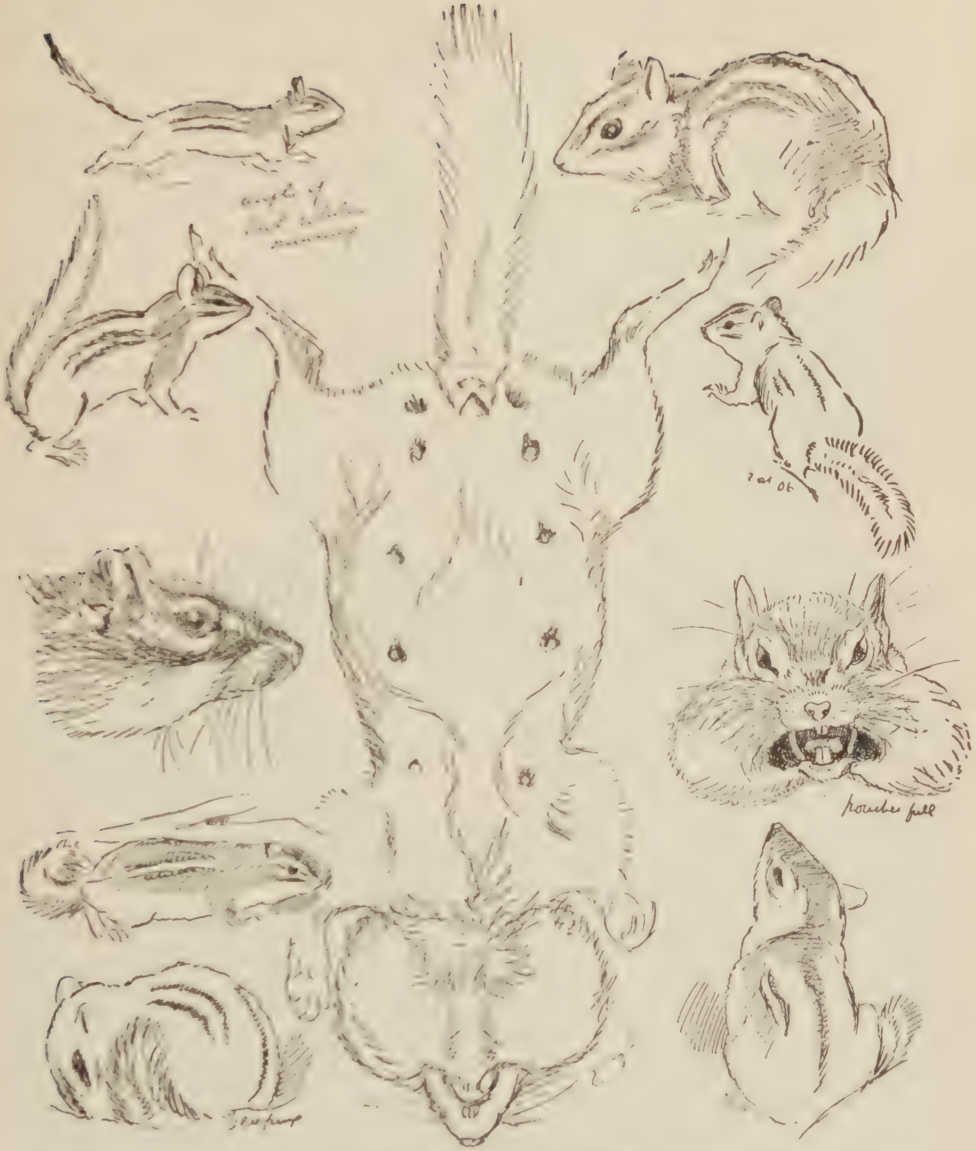


PLATE XVII.—MASTOLOGY, POSES, ETC., OF COMMON CHIPMUNK (*T. striatus*)

The central figure is to show the musk glands on either side of the anus turn its head sidewise to get in at all. I once saw a Chipmunk enter a cage in my menagerie through the inch-mesh wire. He so crammed his pouches with corn that, like Æsop's Skinny Mouse, he could not get out again.

The method of filling the pouches is admirably described by the talented naturalist cited above. He says:

"Some years ago, I watched one of these animals whilst laying up its winter store. As there were no nuts to be found near, I furnished a supply. After scattering some hickory nuts on the ground near the burrow, the work of carrying in was immediately commenced. It soon became aware that I was a friend, and approached almost to my feet for my gifts. It would take a nut from its paws and dexterously *bite off the sharp point from each end*, and then pass it to its cheek-pouch, using its paws to shove it in; then one would be placed on the opposite side, then again one along with the first, and finally, having taken one between its front teeth, it would go into the burrow. After remaining there for five or ten minutes, it would reappear for another load."[32]

His Banking Methods

The Gray-squirrel stores its food in numberless places, sometimes a single nut in each. Usually these are found in the ground, where it could not utilize them during frosty weather. Maybe this points to a Southern origin for the species. The Red-squirrel, a creature of more Northern range, and yet rarely hibernating, stores its food in one or two large storehouses where it can find it, when most it is needed—no matter how hard the frost or deep the snow. The Chipmunk seems to do it both ways, or to compromise between them.

"In addition to their storehouses," Dr. Merriam observes,[33] "they frequently, like the Gray-squirrel, make little caches, burying here and there beneath the leaves the contents of their cheek-pouches."

A Chipmunk in the act of making a deposit, was watched by Ira Sayles, of Rushford, Allegany Co., N. Y. He saw the little animal coming through the garden with bulging cheek-pouches. It began to dig under the dry leaves till half out of sight. Presently, as the writer says, the Chipmunk "became comparatively quiet. In this state, he remained, possibly half a minute. He then commenced a vigorous action, as if digging deeper; but I noticed that he did not get deeper; on the contrary, he was gradually backing out. . . . But this vigorous labour could not last long. He was very soon completely above ground; and then became manifest the object of his earnest work; he was refilling the hole he had made, and repacking the dirt and leaves he had disturbed. Nor was he content with simply refilling and repacking the hole. With his two little hand-like feet, he patted the surface, and so exactly *replaced the leaves* that, when he had completed the task, my eye could detect not the slightest difference between the surface he had so cunningly manipulated and that surrounding it. . . . He raised himself into a sitting posture, looked with a very satisfied air, and then silently dodged off into a bush-heap, some ten feet distant. Here he ventured to stop and set up a triumphant '*chip, chip, chip.*'

---

[32] Q. N. A., I., p. 70.

[33] Mamm. Adir., p. 235.

"It was now my turn to dig, in order to discover the little miser's treasures. I gently removed enough of the leaves and fine muck to expose his hoard—half a pint of buttercup seeds (*Ranunculus acris*). I took out a dozen seeds or so, re-covered the treasure as well as my bungling hands could and withdrew."[34] This hoard was evidently the result of several deposits.

I think, however, that Kennicott was right in holding the view that these little caches are for temporary use; long before winter, all the Chipmunk's stores are doubtless contained in one or two granaries. The Illinois naturalist thus comments:

"The quantity of nuts, acorns, and seeds sometimes collected by these industrious little fellows is astonishing. They are frequently stored temporarily under logs, and in shallow holes under roots of trees, and afterward removed to the burrow at a more leisure season. I have known lazy people to watch the Chipmucks in nutting time, and finding where they carried their stores, dig them out, saying they could thus get nuts faster than by picking them up themselves."[35] Which sounds very like stealing the coppers from a baby's bank.

A burrow opened in January by Audubon and Bachman is thus described: "There was about a gill of wheat and buckwheat in the nest; but in the galleries we afterward dug out, we obtained about a quart of the beaked hazel nuts (*Corylus rostrata*), nearly a peck of acorns, some grains of Indian corn, about two quarts of buckwheat, and a very small quantity of grass seeds. The late Dr. John Wright, of Troy, in an interesting communication on the habits of several of our quadrupeds, informs us, in reference to the species, that 'it is a most provident little creature, continuing to add to its winter store, if food is abundant, until driven in by the severity of the frost. Indeed, it seems not to know when it has enough, if we may judge by the surplus left in the spring, being sometimes a peck of corn or nuts for a single Squirrel.'"[36]

---

[34] Amer. Nat., June, 1870, p. 249.

[35] Quads. Ill., p. 72.

[36] Q. N. A., I, p. 70.

Evidently these two famous naturalists overlooked the fact, already noted, that spring is the time of the hard pinch. The spring pile they speak of was not the remnant, but the whole stock. The quantity described above was about 12 quarts. A peck (8 quarts) for each Chipmunk was possibly a bushel for the family. Kennicott says, "In a burrow dug open in November, I found over half a bushel of hickory nuts and acorns."[37] I doubt not that in March, he would have found just as large a pile.

A Perverted Instinct

Prof. Klugh writes of his Chipmunk: "Erythro gave me the only example of defective instinct which I have come across in my studies of Chipmunks and Red-squirrels. At the place where we fed these Chipmunks, there was a patch of gravel from the beach, and we often put peanuts down on this. Nipper and Fuzzy-tail picked out the peanuts—by sight checked by smell, as far as I could judge—with certainty, but Erythro would pick a peanut, then a small round pebble, another peanut, more round pebbles, and load them all into its pouches. Instead of improving as time went on, its discrimination grew worse, till it would come and fill its pouches with nothing but stones, taking even rather large flattened stones which it could hardly cram into its mouth, and go off with its pouches hanging down from the weight of the stones which rattled at every bound."[38]

The Song from the Stump

It may be assumed that every creature that has vocal cords and joyful emotions, has a song. Nevertheless, we have for long considered the birds to be exclusive possessors of the gift. That we have been unfair to the beasties is now obvious.

The Chipmunk is a notable example of this injustice. In the spring woods of Connecticut, there are to be heard, we may say, a hundred different bird voices; and at least half of them have a less musical, less varied, and less prolonged song than has the Chipmunk.

The usual type of its song is a succession of deep musical "*chock, chock, chock's*" at the rate of two words to the second. Most curiously, this closely resembles the "*chock, chock, chock's*" of a Horse trotting over a concrete pavement some quarter of a mile away. Especially is this resemblance evident when the frost in the air of a still morning invests the hoof-taps with a musical ring that completes the similarity.

---

[37] Quads. Ill., p. 72.

[38] Journ. Mamm., Feb., 1923, p. 32

Often, the note is sung a little higher, and sounds like "*chuck, chuck*"; or ever higher, as suggested by "*check, check.*"

The song is varied in time as well as in pitch. Occasionally, the singer increases the rate, and at the same time changes to the "*check, check*" note. Frequently, he varies or finishes with the phrase "*check, check, cherrup-r-r-r,*" which also serves as a danger call.

Besides these songs it has other sounds, one in particular being a trilled whistle of several different notes that it utters when alarmed. This usually accompanies the final rush that it makes into a place of safety; possibly it is uttered in defiance of its pursuer, or it may be like the nervous squeal of a child just escaping being caught in a game.

The following notes show that this furry songster is vocal throughout his active life:

On May 28, 1905, at Cos Cob, I heard a Chipmunk singing; he kept it up for 3 minutes, uttering 3 chirps to the second.

In September, 1906, 11 A. M., *at Cos Cob,* I timed a singing Chipmunk. He kept on for 8 minutes, uttering at the fastest 170 chirps to the minute.

July 2, 1921. Saw a Chipmunk in fine song on the terrace. He uttered over 150 "*chocks,*" then ran off with a "snicker."

On April 29, 1905, at Cos Cob, I heard a Chipmunk in full song. He kept it up for 11 minutes without ceasing, and uttered 130 chirps to the minute. He got no reply, though he worked very hard, and seemed tired toward the last. I made the sketch of him which appears as the upper figure in Plate XX.

May 22, 1926. At 7 A. M., I heard a Chipmunk in song on the terrace. He had "chucked" at least 50 times when I began to count. He gave 648 more, that is, he sang "*chuck*" at least 700 times before he stopped. Altogether it took about 5 minutes or less. He did not use the deep "*chock, chock,*" but rather the high-pitched "*check, check,*" and it was much varied in time.

On June 11, 1905, at Cos Cob, I saw a Chipmunk uttering the "*chuck, chuck*" song at the rate of 15 chirps to 10 seconds. Five or six of his kind were in sight, but only one joined in; it was 100 feet away. When I drew near, they changed to the much higher-pitched danger note, and dived below.

Oct. 2, 1924. A Chipmunk sang for about 15 minutes between 6 and 7 A. M. He must have uttered at least 2,000 "chucks."

Oct. 27, 1905. Chipmunks hard at work gathering nuts, and often singing.

The Chipmunk will sing from some low perch, like a root, stone, or a low wall. I never heard one making this sound while up a tree. I have, however, heard it singing while running about; also while on the ground, as well as when both its cheek-pouches were crammed full.

Both sexes sing.

Thus, the Chipmunk sings at all times, under all conditions, during its active life, from March 1st to Nov. 1st. What bird can claim such a record for constancy?

An Appreciative Audience

The most unexpected of all my notes on this species is the following: "At Greenwich, Conn., on June 21, 1926, on the wall of the rose garden, about 9 A. M., I saw a Chipmunk singing away, surrounded by an admiring crowd of a dozen English sparrows, all of them young. He was so intent, and his audience so thrilled, that I was able to get my camera and make two snapshots (Plate XX, p. 214). Without this evidence, I should hardly dare to describe the scene. A similar incident is recorded for the Gray-squirrel" (page 41).

Hail to the Spring

In Connecticut, the Chipmunks may reappear about the first week of March; in Manitoba, about the first or second week of April—that is, as soon as warm weather has surely set in.

The regularity with which the Chipmunks come with the first soft wind of spring, sets me wondering whether there is not something more than mere verbiage in the phrase, "vernal influence."

Snug in his deep, dark abode, far beyond reach of sun or frost, he cannot be touched by mere temperature; nor can it be that he appears at a set time, as some of our winter-sleepers are said to do. No! He must come forth on the very day when first the very spring is in the land.

A Chipmunk announces his return to sunlight in a manner worthy of a lark. Mounted on some log or root, he reiterates his loud, long, birdy song. Other Chipmunks run from their holes, for they awaken almost in a body. They hurry forth into the sunlight; and, seeking some perch, add their "*chuck, chuck, chuck*" to the spring salute. So the glad news spreads from point to point, from stone-pile to log-heap, to brush-heap and fence, summoning all the race to come forth, and take part in the national rejoicing.

In the wooded parts of Minnesota, the coming forth of the Chipmunks is a recognized event among the young Indians, and is celebrated, Dr.

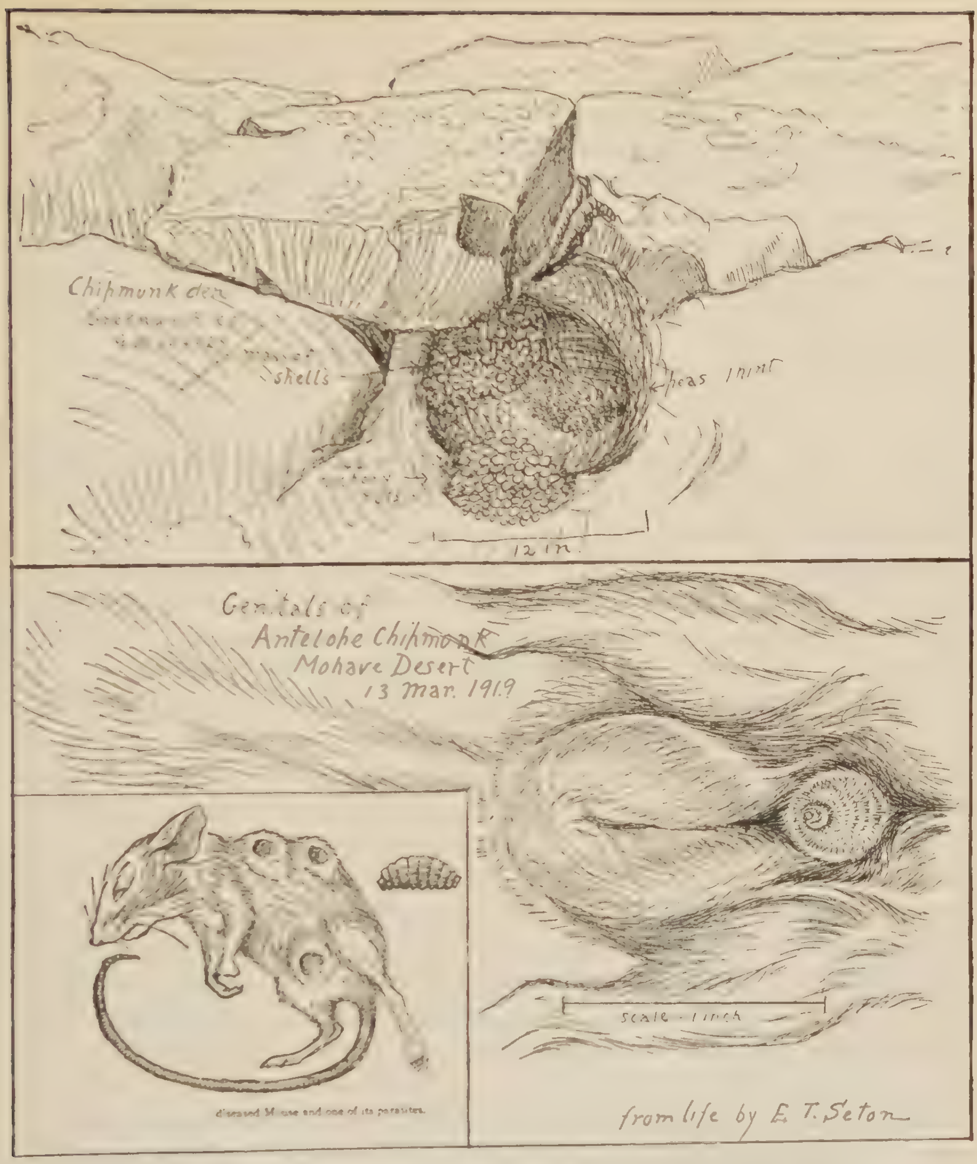


PLATE XIX.—CHIPMUNK DEN, GENITALIA, AND CUTEREBRA

A. Chipmunk's nest. On May 9, 1925, at Little Peequo, Greenwich, Conn., I dug out a Chipmunk's nest, among the rocks. The many burrows were lost in digging. The chamber was 2 feet down, and was about 12 inches across. It contained a quart of hickory nuts (146 in number), a pint of peas (stolen), and a mass of shells like conglomerate, 6 by 8 inches by 4 deep.

B. Genitalia of Antelope Chipmunk, in full activity, about 1½ times life size.

C. House-mouse with 3 Cuterebra. It was dying when found. Taken at Winnipeg, Aug. 25, 1902.

Charles Eastman informs me, by a special hunt. As soon as the bright, warm days of spring arrive to make it possible, the boys go forth between sunrise and nine o'clock to some well-known Chipmunk haunt, where one of their number, who is adept in imitating the creatures' notes, begins the chorus by a loud chirping. The Chipmunks pop out of their holes on all sides. "Sometimes as many as 50 will come together and hold a social reunion."[39] Then, seeking some high perch, these awakened winter-sleepers join in the spring music with a concentrated energy that seems to make them heedless of danger; so that they are approached as they could not be, in their ordinary summer life.

HIS KALENDAR

The earliest appearance I have recorded for this spring awakener is Feb. 21, 1926, Greenwich, Conn., 11 A. M., dull sunlight, 2 or 3 degrees of frost, snow everywhere.

After that, the seasonal notes are as follows: Feb. 22d, out again; March 1st and 2d, active all day. Thenceforth, abundant all summer till late July, when the mysterious summer holiday took place for two weeks. (See later.) Other years, it has not come out till early March.

Each year at Cos Cob and Greenwich, I have noted the practical disappearance in July or August of the hitherto abundant Chipmunks. I do not know of any satisfactory explanation; for when September comes, they seem as numerous as ever.

Since the above was written, I have made more complete observations. In the summer of 1926, at Greenwich, Conn., 3, or possibly 4, pairs of Chipmunks bred in and around my house terrace. Half a dozen were commonly seen at one time. When the young were active in June, there seemed to be at least 20 or 30 about. The feeding bank had one or two Chipmunks on it all day. If I may reckon each new appearance as a new Chipmunk, I saw *hundreds* in a day. But with the end of July came a change. Chipmunks became rare.

My record of Chipmunks seen during the successive days of August, is as follows: 1, 0, 0, 0, 0, 0, 0, 1, 0, 1, 0, 0, 1, 2, 0, 0, 1, 0, 0, 0, 0, 0, 1, 0, 1, 0, 0, 1, 2, 1, 2. The first half of September showed further diminution, the score being: 0, 0, 0, 0, 0, 1, 0, 0, 0, 1, 0, 1, 0, 1, 1, 0. On the 17th, a change was seen, and the record thenceforth runs:

17th, 1, and in song
18th, 4, 1 in song

25th, 5 or 6, 4 in song
26th, 5 or 6, 4 in song

---

[39] Indian Boyhood, 1902, p. 92.

19th, 1, and in song
20th, 1
21st, 2, both in song
22nd, 2, 1 in song
23rd, 2
24th, 4 or 5, 1 in song
27th, at least 6, much singing
28th, " " 6, " "
29th, " " 6, " "
30th, now plentiful, though much less so than in July

The blank period is usually a time of excessive heat; in 1926, also of thunderstorms. Still, these conditions do not seem to explain the hiatus of æstivation.

Each year, after August, the Chipmunks reappear in numbers. My latest entries at Greenwich, Conn., are Nov. 4, 7, 15, and 19, 1922. In 1925, I saw one Nov. 25th, although there was snow on the ground. They were quite lively till they disappeared.

His Way of Life

The Chipmunk has the vivacity as well as the voice of a bird, combined with the manners of a Squirrel. In his disposition he has something even of the Rat, but his exterior is so attractive that one readily forgets the evil strain that betrays this low relationship.

His combined nervousness and curiosity are admirably pictured thus by Merriam:[40]

"He is partial to brush-heaps, wood-piles, stone walls, rail fences, accumulations of old rubbish, and other places that afford him a pretty certain escape, and at the same time enable him to see what is transpiring outside. For, though by no means wary, he delights in these loosely sheltered hiding places, where he can whisk in and out at will, peep unobserved at passers-by, and dart back when prudence demands. If suddenly surprised, he utters a sharp '*chip'-per'-r-r-r*,' and makes a quick dash for his retreat, which is no sooner reached than, simultaneously with the disappearance of his tail, out pops his head, his keen dark eyes gazing intently at the source of alarm. If not pursued farther, he is very apt to advance toward the supposed enemy, betraying his excitement by a series of nervous starts and precipitous retreats, till finally, making a bold rush, he dashes by the object of his dread, and in another instant is peering out from a hole beneath the roots of a neighbouring tree.

"Though a very inquisitive creature, this habit does not seem to be attributable to curiosity alone, but rather to the same reckless foolhardiness that prompts the small boy to cross and recross the road in front of a swiftly advancing carriage or locomotive."

---

[40] Mamm. Adir., p. 237.

Aloft and Afloat

Although at home among tangled underbrush and log heaps, the Chipmunk is a poor climber compared with the Red-squirrel. He seldom goes far from the ground, and never for sport; he usually climbs for food or for refuge.

Regarding this point, Kennicott says: "Dr. Hoy informs me that he once observed a number of Chipmucks climbing the bushes of the prickly ash (*Xanthoxylum americanum*) to obtain the berries, which they were carrying to their burrows in considerable quantities. At another time, he saw one repeatedly climb a hickory, and cut off the unripe nuts, which were brought to the ground; and, while yet covered with the green pericarp, placed in a hole at the root of the tree which, however, was not its burrow; and he was told that the same individual was noticed to carry away nuts in this manner for some days. Though this species does not generally climb trees, except when pursued, I am inclined to think it does so voluntarily more frequently than is supposed."[41]

Merriam records having seen Chipmunks gathering beech nuts at a height of 60 feet up the trees;[42] and William Brewster writes me: "I saw one in Concord last June (1904) climb an elm 50 feet in height to the very topmost slender spray, where it remained several minutes eating elm seeds. I have never before known a Chipmunk essay such a feat of tree climbing."

I have several times seen the same thing at lesser heights, and usually found the individual immature. If, when pursued, they cannot find a hole, they commonly scramble up a tree; but are then far from being at home, and soon make up their minds to come down, especially if inspection show that no Dog be about. In spite of sticks and shouts, they descend till almost within reach; then, with a final rush, they reach the ground and, usually, some safe refuge that they had decided on while up aloft.

An exciting chase of a Chipmunk by a Brown Weasel is described by J. W. Curran, of Montreal, in *Forest & Stream* for June 2, 1900. It happened at Lake Couchiching, Ont., in July, 1889. The Chipmunk took to the water, closely followed by the Weasel. After a chase of 100 yards, the former drew away from his foe, and escaped.

The Winter Sleep

The Woodchuck goes down sharp on time, with little regard to weather; but the Chipmunk's autumnal disappearance seems prompted solely by the frost. If that come in September, he makes his final bow the day before; if the cold hold off till December, the Chipmunk postpones his departure correspondingly.

---

[41] Quads. Ill., pp. 71–72.

[42] Mamm. Adir., p. 238.

In my notes made during several years in Toronto, I find odd Chipmunk records all through October, and this final entry for Nov. 1, 1889: "To-day the Cat brought in a newly killed Chipmunk, showing that they still come above ground, although there has been a good deal of frost. The weather is now mild."

A captive specimen which I kept (also at Toronto) was active all winter when in a warm room; but as soon as exposed to a temperature near freezing point, he curled up in his sleeping place, and took no further interest in the affairs of the active world.

As light on the obscure chapter of his life that the Chipmunk passes in winter, Col. Wirt Robinson, U. S. A., writes:

"At this place, West Point, N. Y., on March 15, 1907, the weather very cold and the Hudson River still frozen over, on my way to my office, I passed some workmen who were moving a large boulder which was threatening to slide down into the roadway. As they rolled it over, I saw underneath it the galleries of some small animal, and, in one corner, a ball of dried leaves. On opening this, I found inside a Chipmunk, tightly coiled up, eyes closed, cold to the touch, and stiff and rigid. I moved it to another spot, placed it where the sun would strike it, and covered it with some dry leaves.

"Two hours later, I returned, and found it with its eyes open, but still stiff and unable to move. I put it in my overcoat pocket, which I hung up in the warm building for an hour or so, and forgot about the Chipmunk. In putting on the coat later, I slipped my hand into my pocket, and the Chipmunk promptly bit me severely, its incisors passing through my finger nail. When I reached a suitable spot, I released it and it scampered off, now perfectly alert."[42]

When the bright, glad summer-time is gone, the pert, live Chipmunk, like Proserpina of the flowers, sinks down to Pluto's dark and drear abode, to pass the coming months in gloom and deathlike sleep.

In apparent contradiction to this are the observations of Dr. T. J. Henry of Apollo, Pa., who says of his pet Chipmunk: "Even during the coldest days of winter, if the cage was tapped upon, the young one would come out and take what food was offered, although there was a plentiful supply in store. As the cage was not kept in the house, it was several times below zero when he responded to my call. This indicates that they do not lie dormant, as some suppose."[44]

---

[42] Journ. Mamm., Nov., 1923, pp. 256–57.

Thus we have an unsolved problem in the winter life of the creature.

There is yet another mystery about the Chipmunk. Animals which hibernate become enormously fat just before their retirement; this is a supposed essential of the procedure. Yet the Chipmunk does not. Of 40 specimens secured by Rhoads[45] at Greenwood Lake, N. J., in the last of October, "no really fat one was found among them, though the acorns, which they were busily harvesting and storing away, were abundant."

One might argue from this, that their torpor is not very profound. Kennicott and Bachman made observations that lead to this same conclusion. Of those that the latter unearthed in January under five inches of snow, he says:[46] "They were not dormant, and seemed ready to bite when taken in the hand; but they were not very active, and appeared somewhat sluggish and benumbed, which we conjectured was owing to their being exposed to sudden cold from our having opened their burrow."

My own observations at Toronto would prove the lethargy complete; and this raises the question as to whether latitude is not a factor in the case.

Many naturalists testify that a spell of bright, warm weather in midwinter will tempt the Chipmunks forth; and if, as happens in the Southern States, the winter should pass without sharp or continuous frost, the Chipmunks probably do not find it worth while to go into the long sleep at all.

Autumn Joy

But before his final plunge, he is wont to make a public farewell scene. Toward the end of October in southern Ontario and Connecticut, and in September in Manitoba, his kind vary their labours of storing food by a musical outburst that closely resembles the chorus of spring. We are reminded of the vineyard scenes in Europe where the moon of vintage is a time of festival, joyously expressed in song and dance.

On a bright and warm day, some lusty Chipmunk gets up on a perch, and begins to "*chuck-chuck-chuck.*" If psychologically well-timed, his invitation at once provokes abundant and rapturous response. Every Chipmunk mounts his song-perch—and each has his own—and they make the woods ring for several minutes with their united voices.

We must remember that the winter is a period of perpetual sleep with them; they are practically dead from October to March. This autumn outburst of song then is but a *few active days* before their mating season in March. I wonder, therefore, whether the performance has not in it something of erotic impulse.

---

[44] Guide to Nature, Jan., 1909, p. 365.

[45] Mamm. Penn. & N. J., p. 62.

[46] Q. N. A., I, p. 70.

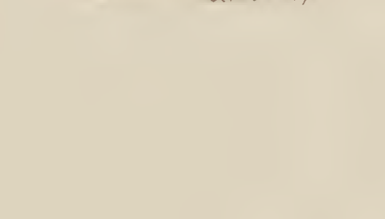
References

1849—Quadrupeds of North America, by Audubon and Bachman, I, pp. 65–75.
1857—Quadrupeds of Illinois, by Robert Kennicott, pp. 70–73.
1884—Mammals of the Adirondacks, by C. Hart Merriam, pp. 233–39.
1903—Mammals of Pennsylvania and New Jersey, by Samuel N. Rhoads, pp. 61–63.

LIFE LXXIII—SAY'S CHIPMUNK

PAGE
Names 218
Description: Size, Colour, Weight 218
Races 219
Range and Haunts 220
Food 221
His Bank Account 222
Does He Sing? 223
Corridors and Chamber 223
The Little Copperheads 224
The Foes of the Two-Bar Chip 224
The Winter Dread 224

References 225



Golden Mantled Ground-squirrel, Rocky Mountain Chipmunk, Big Chipmunk, Say's Chipmunk, Golden Chipmunk, Calico Squirrel, Copperhead, Two-bar Chip, Bummer, Copper Chip, Callo, Copper Callo, Calico Chip, Side-striped Ground-squirrel. Two-striped Chipmunk, Rock Squirrel, Tiger Squirrel

Callospermophilus lateralis (Say)

(Gr. *kalos*, beautiful; *sperma*, seed; *philos*, loving; L. *lateralis*, of the sides, referring to the conspicuous stripes)

S[ciurus] lateralis SAY, 1823, Long's Exped., Rocky Mts., II, p. 46.
Callospermophilus lateralis MERRIAM, 1901, Proc. Wash. Acad. Sci., III, p. 563.

TYPE LOCALITY—Arkansas River, 26 miles below Canyon City, Colo.

The genus *Callospermophilus* (Merriam, 1901) comprises Squirrels that live chiefly on the ground. They have Squirrel-like form; but the tail, which is bushy, is only half the length of head and body. They have cheek-pouches; conspicuous stripes along the body. The ears come between those of the Chipmunks which have long ears (that is, ½ inch long), and those of the Ground-squirrels of the Citellus group, which have short ears. Teeth:

$$\text{Inc.}\ \frac{1-1}{1-1};\ \text{prem.}\ \frac{2-2}{1-1};\ \text{mol.}\ \frac{3-3}{3-3} = 22$$

As seen perched high on his sunning rock, the Golden Chipmunk looks like an unusually large gray Common Chipmunk, with a yellow head, and two black stripes on each side. The true Chipmunks have stripes on cheeks also.

A fine, typical male which I collected near Taos, N. M., Aug. 15, 1915, has, added to the generic characters, the following:

Size. Length, 11 in. (279 mm.); tail, 3¾ in. (95 mm.); hind foot, 1¾ in. (44 mm.).

Colour. All above, it is of a pepper-and-salt gray, tinged warmer and browner on the rump and buttocks; on the snout, it is suffused with a sienna or yellowish brown, which passes over the cheeks on to the neck, shoulders, and fore feet. This is the golden mantle. On each side are two parallel black stripes from shoulder to hip, the lower twice as wide as the upper, with a dull, yellowish white stripe between them; the white stripe begins in a brownish white patch just behind the ear, and dies out on the rump nearly an inch beyond the black stripes. The eye-ring and all below, including the paws, are of a dull yellow-white. The tail is black above, and plentifully overlaid with yellow tipping to the hair; and buffy or grayish yellow below, with an edging and terminal bar of black.

Weight. No weights of the species are at hand, but its Sierra cousin of nearly the same size is given as follows: males, averaging 6 oz., females, 7.[1]

RACES

The following races have been recognized:

lateralis Say, the typical form. T. l., Arkansas River, near Canyon City, Colo.

caryi Howell, like *lateralis* and *castanurus*, but grayer; white stripes clearer; under tail, darker than in *lateralis*, but much paler than in *castanurus*. T. l., Fremont Peak, Wyo.

certus Goldman, of pale general colour; under-side of tail dark russet; similar to *bernardinus*, but paler. T. l., Charleston Peak, Clark Co., Nev.

saturatus Rhoads, like *lateralis*, but tail long, and colours very dark. T. l., Lake Keechelus, Kittatas Co., Wash.

cinerascens Merriam, like *lateralis*, but back gray instead of brown. T. l., Helena, Mont.

tescorum Hollister, much like *cinerascens*, but larger, darker, and more richly coloured. T. l., Near Moose Pass, B. C.

chrysodeirus Merriam, black side stripes about equal in size; mantle and underside of tail yellow; tail and hind foot short. T. l., Fort Klamath, Ore.

perpallidus Grinnell, like *chrysodeirus*, but paler; back more ashy; black stripes sharply defined. T. l., White Mountains, Mono Co., Calif.

trinitatis Merriam, like *chrysodeirus*, but larger, and of darker colours; underside of tail chestnut. T. l., Trinity Mts., Humboldt Co., Calif.

---

[1] Ground Squirrels, p. 676.

bernardinus Merriam, like *chrysodeirus*, but with shorter tail and hind foot. T. l., San Bernardino Peak, San Bernardino Co., Calif.

castanurus Merriam, like *lateralis*, but underside of tail deep chestnut; black side stripes about equal in size; mantle chestnut. T. l., Park City, Wasatch Mts., Utah.

madrensis Merriam, like *lateralis*, but tail about half as long; grayer in colour; black stripes nearly obsolete. T. l., Sierra Madre, near Guadalupe y Calvo, Chihuahua, Mex.

trepidus Taylor, like *chrysodeirus*, but larger, and paler; underparts white; upper dark side stripe narrower than the lower. T. l., Pine Forest Mts., Humboldt Co., Nev.

wortmani Allen, like *lateralis*, but paler, and with upper side stripe of black obsolete. T. l., Bitter Creek, Sweetwater Co., Wyo.

RANGE AND HAUNTS

Map VII, (p. 252) shows the Copper-chip or Copperhead to be at home in the Canadian and Transition Zones of the Rocky Mountains, from the upper Athabaska to northern Mexico. Occasionally, as Warren writes me, it is found in the dwarfed evergreens just below timberline in Colorado. This is the upper part of the Hudsonian. More than any other of its group, it is a Rocky Mountain creature—the golden mantled climber of the golden ore-streaked rocks. The popular legend that there is gold wherever the Golden Chipmunk frisks, is at least worth smiling remembrance.

Within the very definite limits indicated, it shows, as Grinnell and Dixon say, "decided preference for rocky slopes or forest floors littered with logs, but at the same time without heavy undergrowth. *Open* ground is preferred; yet it keeps out of large grassy meadows, save as visiting the margins of these where they adjoin the woods. . . . In the higher, rougher parts of the mountains, we have often found the Copperheads inhabiting rock slides. Here as in the other places, where there are logs or scattered rocks, the object appears to be to secure protection for their burrows; so that these can be located beneath heavy objects, and thus prove difficult or impossible for Badgers, Coyotes, or Bears to dig out."[2]

These, indeed, are his haunts for half the year. But the first chill wind in the middle of the Falling Leaf Moon sends him down to sleep with his kindred, the Sleepers Seven; till, in mid-March, once again he comes, as the birds come from the South.

---

[2] Ground Squirrels, p. 679.

Food

My own observations on this creature's food, show it to be much like its kin in tastes and diet. It loves grain, nuts, and seeds, as first choice; but eats fruits, roots, grasses, and herbage, where more alluring foods are scarce.

Warren writes me: "I have seen these animals up in pinyon trees, gathering the nuts, near Crestone in San Luis Valley. As noted in *Mammals of Colorado* (p. 168), they also gather acorns of scrub oaks."

Like its group, it is ever ready to vary its table courses with insects and flesh. This view is endorsed by Grinnell and Dixon in the following paragraphs: "The Golden-mantled Ground-squirrel is a Spermophile in the truest sense of the word; it is preëminently a gatherer and eater of seeds, and most of its time above ground seems to be occupied in diligent search for this sort of food. . . .

"Some seeds identified in cheek-pouch contents saved are: Goose grass (*Galium aparine*), rice-root lily (*Fritillaria* sp.), pentstemon (*Pentstemon azureus*), and silver pine (*Pinus monticola*). In the summer and autumn months, great activity is shown in garnering chinquapins. . . .

"One individual had its cheek-pouches crammed with fragments of a brown-coloured fungus such as forms bracket-like outgrowths on the bark of dead trees and old logs. Our experience shows this article of diet to be much sought after by members of the Squirrel tribe generally.

"Then, too, the Golden-mantled Ground-squirrel eats meat, and even carrion, as we can testify from the persistency with which our meat-baited steel traps set for Coyotes and other carnivores, are sprung by the Copperheads. Indeed, it seems reasonable to infer that this Ground-squirrel would lose no opportunity to appropriate to its use the dead remains of any sort of animal. Around camp sites, we have often received good evidence of the omnivorous nature of the Copperheads' diet from seeing them gathering the scattered barley from the ground where the Horses had been fed, and then gleaning the scraps of cooked meat, as well as breadcrumbs, from our own table near by. In one case, a 'Callo' came again and again to gnaw at a bacon rind."[3]

E. R. Warren, writing of the Yellowstone race (*cinerascens*), says: "A few years ago, when two friends and myself were riding along one of the roads in the Park [we] saw the Squirrel come up on a log carrying a young Meadow-mouse (*Microtus* sp.) in its mouth. Sitting upright on the log, and holding the Mouse in its paws, the Squirrel proceeded to eat the Mouse, beginning at the head; and ate the head and part of the body while we watched it. As this was on the edge of a meadow, the Mouse had probably been caught in the grass.

---

[3] Ground Squirrels, pp. 679–80.

"No doubt these animals destroy quite a few eggs and young birds during the breeding season, and in this way may be considered harmful; while the destruction of such an animal as the Meadow-mouse may be called beneficial."[4]

His Bank Account

The Calico-chip would not be worthy of his cousins on both sides of the house, *Tamias* and *Citellus*, if he did not, in some convenient bank, store up for a rainy day--or a frozen day, as the case may be.

Thus, Grinnell and Dixon discuss him in his hoarding bent: "The cheek-pouches in this Squirrel are developed to a maximum degree, and it is no uncommon thing to see an individual returning to its burrow from a foraging expedition, with its two pouches so distended with seeds that the head seems double its ordinary width. We have counted 636 seeds from the two pouches of one Squirrel."[5]

"That not all the food gathered, over and above what is immediately eaten, is carried to some definitely located storehouse, is shown by an observation by W. P. Taylor (Ms.). On the summit of Cloud's Rest, Yosemite Park, a 'Callo' was encountered which was so used to the almost daily visits of people as to have become remarkably tame. It would run up to within three feet of a person, take the dried fruit thrown down for it, stuffing its cheek-pouches to capacity, and then run off just a little ways. After digging out a little hollow in the ground with its front feet, it placed the fruit therein, and proceeded to cover it up with earth, using its front feet again. Sitting over the spot, it reached out to gather in additional loose stones, until the cache was effectually concealed. Such hiding places as these are probably used only temporarily, at times when an abundance of food is suddenly available, to be stowed safely from someone else's reach as soon as possible, and later reclaimed for more permanent salvage."[6]

"There seems good reason to believe that large stores of these [chinquapins] and various seeds are then housed away in the ground for use the following spring, when the animals come out of hibernation, and food is difficult to find otherwise."[7]

---

[4] Mamm. Colo., p. 168.

[5] Ground Squirrels, p. 679.

[6] As above, p. 680.

[7] As above, pp. 679–80.

"The young, but a third grown, show almost as much industry in carrying away food as do the adults."[8]

Warren writes me: "At Long's Peak Inn, Estes Park, these Squirrels are so tame about the Inn, that they take peanuts freely from anybody's fingers, climb up into one's lap. After eating one or two, they stuff their cheek pouches with the kernels, scamper off to store them, but soon return for more. The Inn sells a surprising lot of peanuts to feed these animals during the tourist season."

Does He Sing?

This is the only one of the Chipmunks that is not known to sing. Possibly the answer is that he is not a true Chipmunk, but nearer to the Citellus group. This, however, is not quite convincing, as *Citellus franklini* at least, as well as *Tamias*, has a sweet and lively song.

Grinnell and Dixon say: "This Squirrel seems to be, as a rule, almost devoid of voice. As far as our own experience has gone, there is only a single *chirp* of alarm, not loud nor high-pitched; and even this is uttered but rarely."[9]

However, "one observer (W. P. Taylor, Ms.) has been fortunate enough to run across a talkative individual. This animal was watched as it sat bolt upright on a log, uttering a 'sharp call note, "*to-chick*," sometimes varying this to "*tachack, p'r'r'r'r*."' A 'general squirrel-like quality' was ascribed to these notes. At each utterance, a violent flirt of the tail was given."[10] It is not certain whether this was a song or a call of alarm.

Corridors and Chamber

In the huge and many-tenanted apartment house of the mountain-side, the Rock Chip seeks his home. The doorways and corridors, according to the naturalists cited, "vary in diameter from 2 to 2½ inches; and the direction taken is usually steeply down into the ground for a foot or more. Unfortunately, we have never availed ourselves of an opportunity to dig out the burrow system of a Golden-mantled Ground-squirrel We infer it to be simple and relatively short, for two reasons: the mounds, at the mouths of the burrows are usually small in quantity of earth composing them; and the big roots, logs or rocks beneath which the burrows in practically all cases lead, would seem to do away with the need of an extensive and deeply penetrating system, so as to secure safety from enemies which pursue their prey by digging."[11]

---

[8] Ground Squirrels, p. 680.

[9] As above, p. 679.

[10] As above.

The Little Copperheads

"The young are born mostly in July, but as early as the last of June at the lowest altitudes of occurrence, and as late as the first week of August up near timber line. Young one-half grown were taken on Cannell Meadows, 7,500 feet altitude, Tulare County, on July 7, 1911; and young but a third grown were taken at Cottonwood Lakes, 11,000 feet, near Mount Whitney, Aug. 31, 1911. These dates are the extremes in the considerable series we have for time of appearance of young. Young come above ground when they are as small as one-fourth adult size (as determined by weighing).

"There is but one litter each year. This probably averages close to 5 in number. Six females captured along the central Sierras, of dates June 12 to 28, contained 5, 2, 5, 6, 6, and 5 embryos, respectively. The number of mammæ (represented by nipples) is either four pairs or five pairs."[12]

The Foes of the Two-Bar Chip

"The enemies of this Squirrel," say Grinnell and Dixon, "probably include most of the carnivores of the higher mountains. Hair of a 'Callo' was found in the feces of a Mountain Coyote (*Canis latrans lestes*) in the Yosemite National Park. Near Monache Meadows, in the Sierras of eastern Tulare County, one of the writers saw a Mountain Weasel (*Mustela arizonensis*) in full pursuit of a 'Callo,' across open ground in the full sunshine of the bright forenoon of Aug. 4, 1911. The Squirrel was overtaken by the Weasel; and what happened, transpired so swiftly that no details were observable. A gunshot terminated the episode, and the 'Callo' was found already stone dead, with two tooth-punctures on each side of the nape of its neck."[13]

But these are the obvious enemies, so count for least.

The Winter Dread

Fell Famine, with his league-man, deepening Snow, might well have been the deadliest dread of the bright, rock-haunting Callo-chip. But, wise one that he is, he wholly shuns the combat that would surely spell defeat. And when white Peboan, ghastly, ruthless, comes, grim stalking on the hills, the bright bird-beast of the summer rocks has sought the haven offered by another, stronger yet. Deep in the breast of Mother Earth he curls and sleeps, indifferent, unmoved by the blistering sting, the blizzard onset of the Kings of Death—White Death; and lets them rave and scream and burn things with their cold, till kindly spring comes round and smiles them off the earth—till Mother Carey waves her wand, and all the wood world wakes.

---

[11] Ground Squirrels, p. 679.

[12] As above, p. 680.

[13] As above, pp. 680–81.

References

1910—Mammals of Colorado, by E. R. Warren, pp. 166–70; 1 photo.

1918—California Ground Squirrels, by Joseph Grinnell and Joseph Dixon. Monthly Bulletin Calif. State Commission of Horticulture, Rodent Control Division, Vol. VII, Nos. 11, 12, Nov.–Dec. pp. 675–86; 1 ill.; 1 map.

1927—Notes on the Ground-squirrel, Callospermophilus, by Robert T. Hatt, Occasional Papers of the Museum of Zoology, University of Michigan, Ann Arbor, Mich., No. 185, June 29. 22 pp., 1 pl. of 6 photos, 1 fig. of burrows, 1 scale music of song; chiefly life-history. Received too late for quotation herein.

LIFE LXXIV STRIPED GROUND-SQUIRREL

	PAGE
Names	228
Description: Size, Colour	229
Races	229
Range, Haunts, and Numbers	229
An Unsociable Little Pest	231
Spring Advent	232
Marriage Bond Loose	232
The Runways and the Den	232
The Little Stripers	233
The Birdy Voice	234
Powers and Gifts	234
His Way of Life	235
A Sun Child	235
His Diet	237
As a Mouse and Chicken Killer	238
Food Summary	240
Preparing for Famine	240
Never Drinks	242
Its Foes	242
Parasites	242
His Worst Enemy	244
Last Days on Earth	244
Hibernation	246
His Book Balance	247
References	248

Striped Ground-squirrel, Striped Gopher, Thirteen-Striped Spermophile or Citellus, Hood Spermophile, Leopard Spermophile, Striper, Stripsie, Flag Squirrel, Flag Citelle, Whistling Sneak, Spotted Souslik, Grass Chippie, Grass-runner, Sod-runner, Prairie Striper

Citellus tridecemlineatus (Mitchill)

(L. *Citellus*, the latinized form of the name of the Ziesel or Souslik of Russia, the type of the present genus; L. *tredecim*, thirteen; *lineatus*, lined or striped)

Sciurus tridecem-lineatus MITCHILL, 1821, Med. Repos., N. S., VI (XXI), p. 248.

[*Citellus*] *tredecimlineatus* TROUESSART, 1904, Catal. Mamm. viv. foss., suppl., p. 341.

TYPE LOCALITY—Central Minnesota

FRENCH CANADIAN, *la Citelle* or *l'Écureuil a treize raies.*
OJIBWAY and SAUTEAUX. *Sha-shá-ba Wa-ba-coosh'.*
YANKTON SIOUX, *Tah-sen-a A-das-ka.*
OGALLALA SIOUX, *Tash-nah-hay'-ah-lah.*

It is most unfortunate that in the Northwest generally, this animal should be known by the name of "Gopher." That belongs properly to the *Geomyidæ*. The present has many names peculiar to itself. We should aim at establishing one of these. "Striper" and "Stripsie" were schoolboy names in Manitoba, where the young folks made pocket money by snaring these animals for the bounty.

The genus *Citellus* (Oken, 1816) comprises squirrel-like animals that live on the ground; outer ear various, from almost none to medium; well-developed cheek-pouches; 5 nearly equal toes on hind foot; 4 fingers and a knob-like thumb in front. Teeth:

$$\text{Inc. } \frac{1-1}{1-1};\ \text{prem. } \frac{2-2}{1-1};\ \text{mol. } \frac{3-3}{3-3} = 22$$

In addition to the generic characters, the Striped Ground-squirrel has the following:

Size. ♂ length, about 11 in. (279 mm.); tail $3\frac{7}{8}$ in. (99 mm.); hind foot, $1\frac{1}{2}$ in. (39 mm.); ears, very small and low. ♀ smaller than ♂.

Colour. All above, dark or blackish brown (which varies greatly in depth), with 7 long stripes of dull yellowish white, between which are 6 more or less broken rows of spots, similar in colour to the stripes; the stripes are much broken up on crown and haunches; there are traces of chestnut on the flanks and in the dark stripes. All below dull buff, nearly white on the chin; the tail is yellowish brown or sienna, with a fringe of coarse hairs that are black, but have yellowish white tips. April specimens from Winnipeg are very pale and brown. The female is similar.

When seen on the prairie, its stripes, general olive tone, and short ears readily distinguish it, even if it chance to be near the haunts of the Chipmunks. Its style of uniform is indeed unique; the only approach to it is seen in the Rio Grande Ground-squirrel, which has rows of *white* spots, and is otherwise different.

RACES

Eight races are recognized:

tridecemlineatus Mitchill, the typical form. T. l., Central Minnesota.

pallidus Allen, smaller and paler. T. l., Plains of Lower Yellowstone, Mont.

olivaceus Allen, like *pallidus*, but darker. T. l., Custer, Black Hills, S. D.

parvus Allen, very small. T. l., Uncompahgre Indian Reserve, N. E. Utah.

alleni Merriam, smaller, darker, and more olive than type. T. l., Bighorn Mts., Wyo.

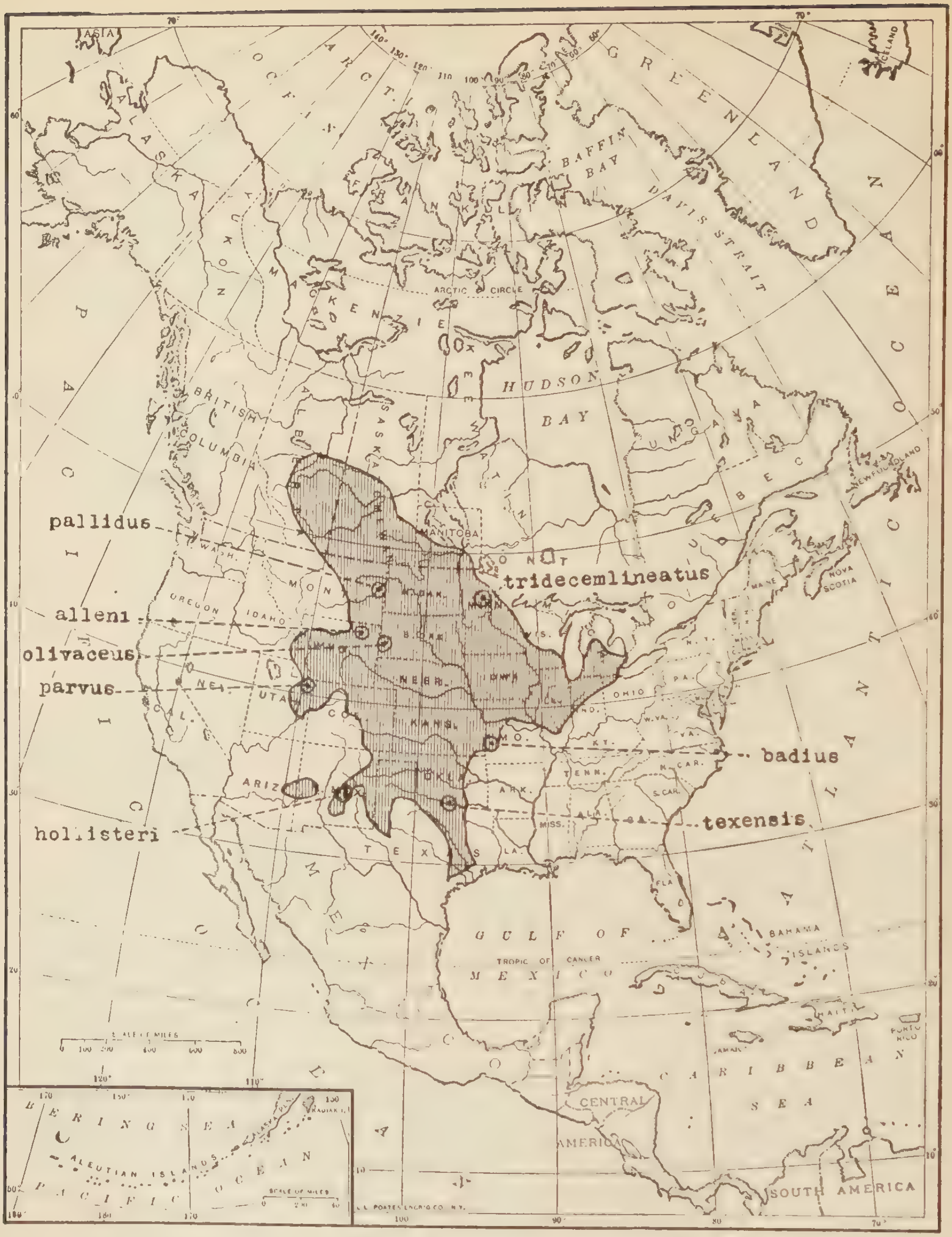
texensis Merriam, like type, but smaller and redder. T. l., Gainesville, Cooke Co., Tex.

badius Bangs, very large and red. T. l., Stotesbury, Vernon Co., Mo.

hollisteri Bailey, smaller and darker than *pallidus;* larger and darker than *parvus;* much like *alleni*, but darker back and crown, and light stripes more continuous. T. l., Elk Valley, Mescalero Indian Reserve, Lincoln Co., N. M.

RANGE, HAUNTS, AND NUMBERS

This is a creature of the rank, grass-grown prairies, a sneak in the grass; but it has also sent out its armies to possess the high Buffalo Plains. The desert region has offered problems of life that it has not yet completely



MAP VI.—RANGE OF THE THIRTEEN-STRIPED CITELLUS
By E. T. Seton, with assistance of the Biological Survey, 1927

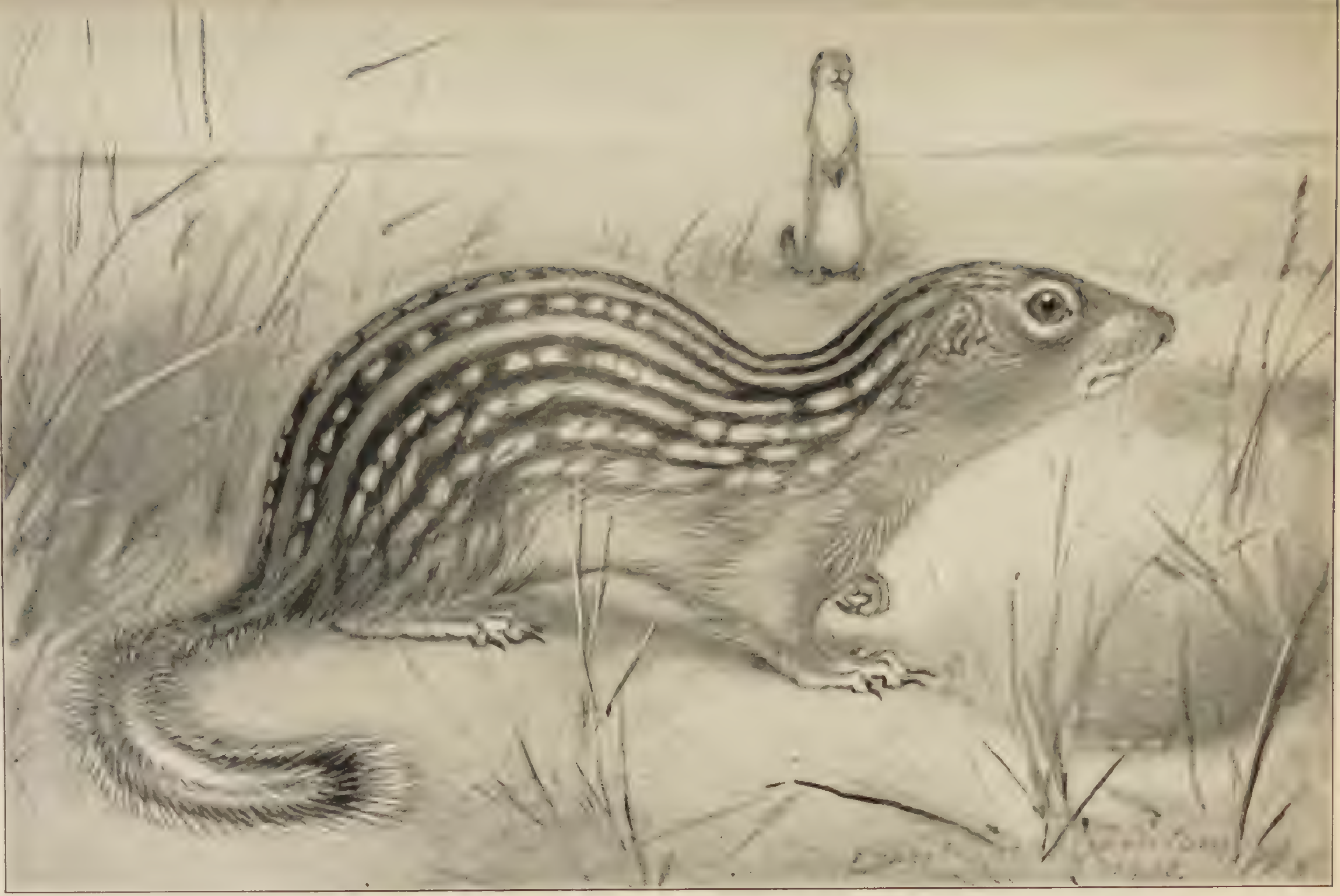


PLATE XXIII.—THIRTEEN-STRIPED GROUND-SQUIRREL (LIFE SIZE)

(*Citellus tridecemlineatus* (Mitchill))
From specimen taken at Carberry, Manitoba

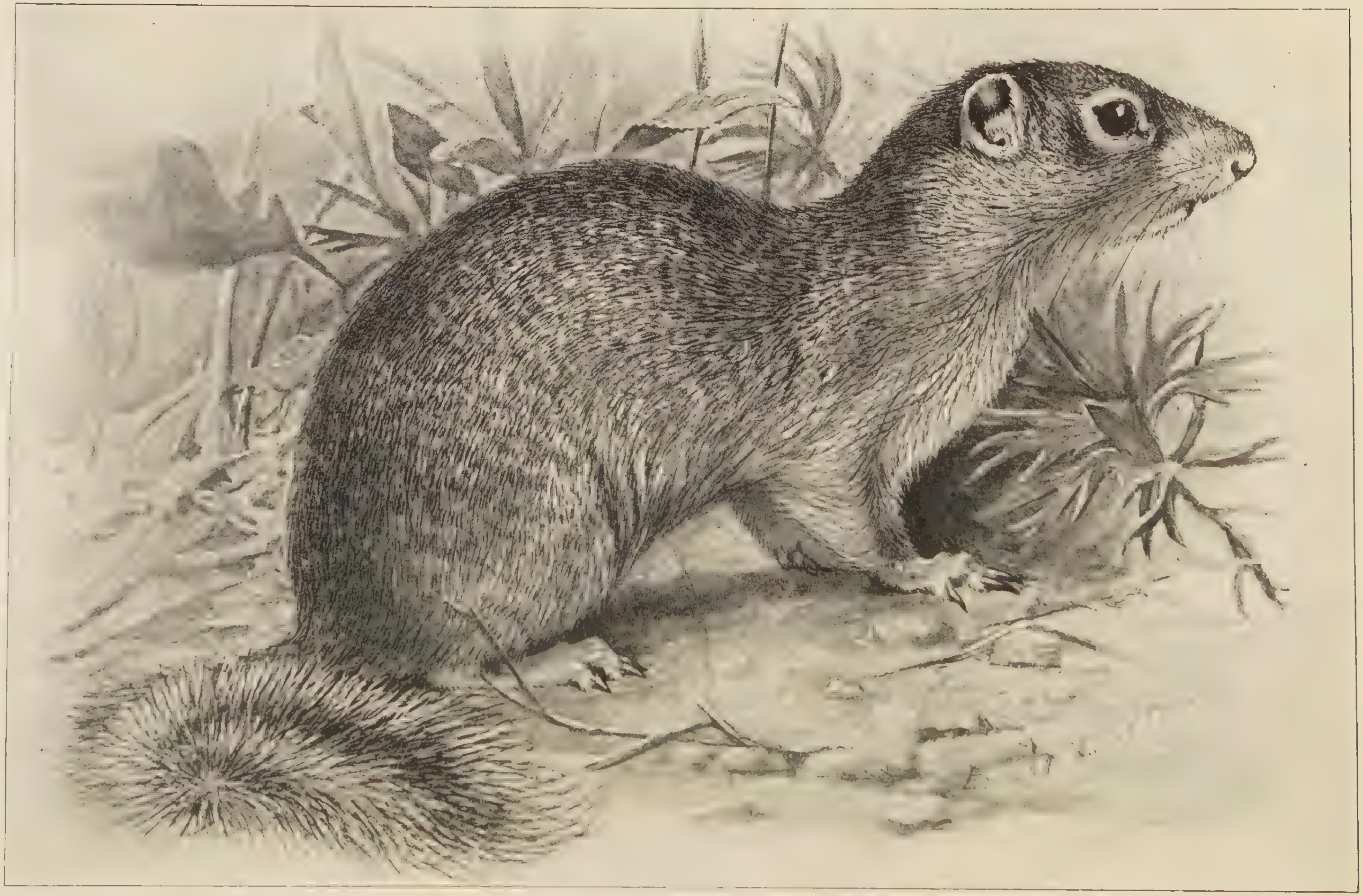


PLATE XXV.—FRANKLIN GROUND-SQUIRREL (ABOUT $\frac{4}{5}$ LIFE SIZE)

(*Citellus franklini* (Sabine))
Carberry, Manitoba, 1892
From drawing made by E. T. Seton for Bailey, Bull. 4, 1893. U. S. Biological Survey, Dep. Agr.

solved. In the form *parvus* alone, has it been able to establish itself on the sage and cactus wastes.

In Manitoba, it is found on all the dry prairies, from Lytleton to Duck Mountain, from Pembina to Selkirk, and from Brokenhead to Fort Ellice; but it is less strictly a prairie species than its yellow congener, and is often seen in the partly wooded country. At Dauphin, I was shown specimens taken there by H. G. Nead; and learned from many that the species abounds on Gilbert Plains and northward as far as Fork River. A few are to be found even farther, along the neighbouring Gravel Ridge east of Duck Mountain. Sir John Richardson records[1] that the species was "in considerable numbers" at Carleton House, but not found beyond north latitude 55.°

The favourite haunts of the Flag Citelle are in dry virgin prairie on a light soil.

It is, or was, particularly abundant on the Big Plain around Carberry, Man. By "abundant" is not meant that its numbers equalled those of the Yellow Ground-squirrel—of that I have seen 50 within an acre—but of the Striped species, 50 in a 10-mile drive would represent its greatest density of population in my experience.

At Grinnell, Ia., it is much more plentiful. John N. Houghton counted 25 during a walk of a quarter of a mile;[2] I never heard of a place in Manitoba where it attained such numbers. It is, however, more numerous than it seems, as its colour enables it to hide so easily; and in 1909, I estimated the population of Striped Ground-squirrels in Manitoba at not less than 250,000. As the range it claims in Manitoba is about 1/25 of its entire territory, this may easily mean a total population of 6,000,000 on its range in those days.

However, it has greatly decreased during the last 20 years. In 1882, one could see 30 or 40 a day without difficulty. One day in the spring of 1884, I caught 13, all males, in our half-acre garden. In 1892, it had become so rare that I seldom saw more than 2 or 3 in a half day's tramping; and reports from all regions under the plough, show that the Flag Squirrel is disappearing.

The reasons for this are more fully set forth in the section on "Its Foes." (P. 242.)

An Unsociable Little Pest

Speaking of its habits in Illinois, Kennicott says:[3] "It is naturally gregarious, and though never observed living in such great companies as the

---

[1] F. B. A., I, 1829, pp. 177–78.

[2] Bailey, Prairie Ground-squirrels, p. 37.

[3] Quads. Ill., pp. 75–76.

Prairie-dog, 20, or sometimes even 50 or 100, may be found within the area of an acre, two burrows being frequently within a few feet of each other, though one is never inhabited by more than a pair."

This does not agree with my own observations. I should rather call it a solitary species, for I never saw one heeding another, except in the breeding season; and those I kept in captivity took no notice of each other except to fight. In one sense, the species may be slightly gregarious, but I should say not at all sociable.

Spring Advent

The Striped Ground-squirrel is rarely seen in numbers until the end of April; but around Carberry, Man., begins to appear about April 20th.

In the backward season of 1904, it had not appeared in force when I went East on May 1st. Again, in the very early season of 1905, Francis Dickie wrote me from Carberry that the first Striped Ground-squirrel was noticed April 1st. At MacDonald, J. S. Charleson noted its first appearance on March 27th.

Marriage Bond Loose

The mating season sets in as soon as they appear above ground, and the males may be seen chasing the females from burrow to burrow over the prairie. Kennicott says that in Illinois they pair, but the male deserts the female just before the young are born, and leads a solitary roving life all summer, "digging a temporary burrow, or occupying a deserted one for a few days wherever he may take up his abode."[4]

The Runways and the Den

The burrows of the Striped Citelle are distinguished from those of the Yellow species by their smaller size (of barely 2-inch calibre instead of 3), also they are on the level ground. They usually go straight down for 6 or 7 inches, sometimes much farther, and rarely have any earth mound visible at the door. Apparently, the animal is at pains to hide the entrance, so gets rid of the earth-pile by scattering it. Bailey remarks:[5] "Though many of the burrows open on smooth, bare ground, with nothing to conceal them, the entrances are more commonly hidden by a bunch of grass, and sometimes a dried weed, a piece of paper, or an old rag is drawn over the entrance."

The tunnels are of at least two kinds. First, a labyrinth of many galleries with many entrances. This is close under the sod, rarely more than

---

[4] Quads. Ill., p. 76.

[5] Prairie Ground-squirrels, p. 33.

3 or 4 inches down. I take it to be a mere playground and refuge; doubtless, also, it serves to mislead such enemies as might be in search of the Ground-squirrel's nest. (See Plate XXIV, p. 245.)

Second, the nesting burrow. This also is a labyrinth, but deeper than the first kind; and it has a large, comfortable chamber about 9 inches in diameter, with many approaches, and more than one entrance. This chamber is about 6 inches down, and is lined with fine, dry grass.

At Carberry, Sept. 8, 1904, I dug out the Ground-squirrel nest from which I made the diagram shown in the Plate. I did not see the rightful occupant, but suppose from its size and character, that it was the work of a Striped Citelle. In one place, as marked, was found a salamander (*Ambystoma tigrinum*). It was not dormant, but very sluggish. (Several times have I found this species thus utilizing the burrows of the Ground-squirrels for its own winter den.) These galleries were much plugged with soft earth, and not easy to trace. They were 1½ to 1¾ inches wide; and most of them about 3 inches down—never more than 6 inches below the surface.

I have also seen another style of burrow that is attributed to this species. It goes down nearly straight for a dozen feet. It may possibly be the winter den, but I never found the bottom or the animal that made it. The natives say it is a well; but I think they are mistaken.

In 1882, I published certain drawings of the prairie in section. They were the four faces of one square hole. The extent to which the burrowing rodents had recently interfered with the surface deposits was very plain; but later studies showed that most of these results were traceable to the Pocket-gopher (*Thomomys*), so that, although the present species is an important secondary worker, the subject is treated in the chapter devoted to *Thomomys*.

The Little Stripers

On May 21, 1884, I dissected 3 female Striped Ground-squirrels that had been shot in the garden, and found in each 9 well-developed young, evidently within a few days of birth. On May 24th, I saw several of this species carrying bedding into their dens. On May 26th, I opened two more, and found 7 and 8 young. Other observers have noted young up to 14; thus, they range from 7 to 14 in number, 9 being the average.

It is a remarkable fact that among the mammals which have large broods, prenatal counting shows more young than actual observation of the litter in the nest. Does this mean the death of one or two at each birth?

Evidently, the little Stripers are born about June 1st. I find this note in my Carberry Journal for May 27, 1884: "The Striper in the cage brought forth her young yesterday or the day before, but she has utterly neglected them (they are since dead). They are perfectly naked, blind, helpless, and apparently toothless. There is not even an opening for the ears. Their skin is bright pink, and shows no signs of hair or of the mature markings. The total length of one is $2\frac{1}{4}$ inches; of this the tail is $\frac{3}{8}$ of an inch. The sex is pronounced, and the whiskers show."

Kennicott records[6] that "Dr. Hoy, who observed them in confinement, says that they have no hair on the body before they are 20 days old, and that the eyes do not open till the 30th day. They continue to require the nourishment and care of the mother for a much longer period than most rodents."

A nest found near Carberry in June was of fine grass a couple of inches below the sod; and contained 8 young Stripers, half grown, but showing all mature markings.

About the first week in July, they are big enough to come out of the den; they are half grown in the middle of the month, but do not yet go far from home and mother. They are fully grown by September; and before the winter comes, the family feeling is entirely gone. Even the young probably do not winter together.

Only one brood is raised each season.

The Birdy Voice

This Ground-squirrel has a much greater variety of whistles and bird-like chirps than the Yellow species, though it is inferior vocally to the Scrub Citelle. Its short, sharp whistle of alarm, and its prolonged quavering defiance, uttered from the safe underworld, are well known to every farm-boy who snares these Grass-runners for pocket money. When held by a trap, it bites its adversary savagely, and utters a sort of angry snarling.

"During the breeding season," says Bailey, "these Spermophiles are quiet and shy, but in June and July, when the half-grown young begin to make their appearance above ground, their voices are most frequently heard. The parent and her young at this time are constantly calling back and forth."[7]

Powers and Gifts

I was greatly surprised to find that this creature could readily climb a low bushy tree, and twice saw one do it as noted in the Food section. (P. 238.)

Its speed is about the same as that of the Yellow Ground-squirrel. But mentally it is decidedly superior.

---

[6] Quads. Ill., pp. 76–77.

[7] Prairie Ground-squirrels, p. 33.

His Way of Life

The Yellow Citelle, no matter how approached, always runs into its hole with nervous haste, as soon as it sees a foe anywhere near. On the other hand, if you find a Flag Citelle sitting by its burrow, and walk straight toward it, it waits till you are within perhaps ten feet, then dives with a little defiant chirrup into its underground safety. If you walk so far as to pass within eight or ten feet, and do not look at it, it seems to watch your eye, and remains perfectly still while you pass. If you step or turn toward it, it dives at once.

If on the prairies the creature be followed, not too fast, it will play with the observer, leading him about in various directions, without seeking a hole. I remember once (July 16, 1892) following one for a hundred yards or more in a very crooked course; then, so far from hieing earthward at last, it took to a field of standing wheat and eluded me in that, giving the usual chuckle of defiance as it disappeared.

If, however, it be hotly pursued, it makes for its earthworks shelter. The faint signs of runways that we see in the grass are no doubt very big, plain fingerboards to it—the Citelle who runs may read. Its course, though erratic to us, is always by these road-blazes directed accurately to a haven; and when at length it stops and looks at the pursuer, he may be sure that it is now at the door of its den; and on a nearer approach, will dive with the usual twitter of derision.

But possessed of an uncontrollable curiosity, it is sure to peep out again if all be still; and it is easily taken then in a noose laid over the hole where it first disappeared.

When I kept the two species together in a cage, the Striped one mercilessly bullied its larger brother, and lost no opportunity of impressing it with the superiority of mind over matter.

This animal has a habit of sitting bolt upright on a mound; it makes itself as tall as possible to look around. Its paws are pressed in close to its breast, and at a distance, it looks like a picket-pin or a stake driven into the ground. At such times, the uninitiated often take the Squirrel for a surveyor's landmark, until a nearer approach causes the supposed stake to dive into the mound.

A Sun Child

The Flag Citelle is strictly diurnal, and so partial to warmth that it is not often seen above ground before the sun is in full force—that is, 9 or 10

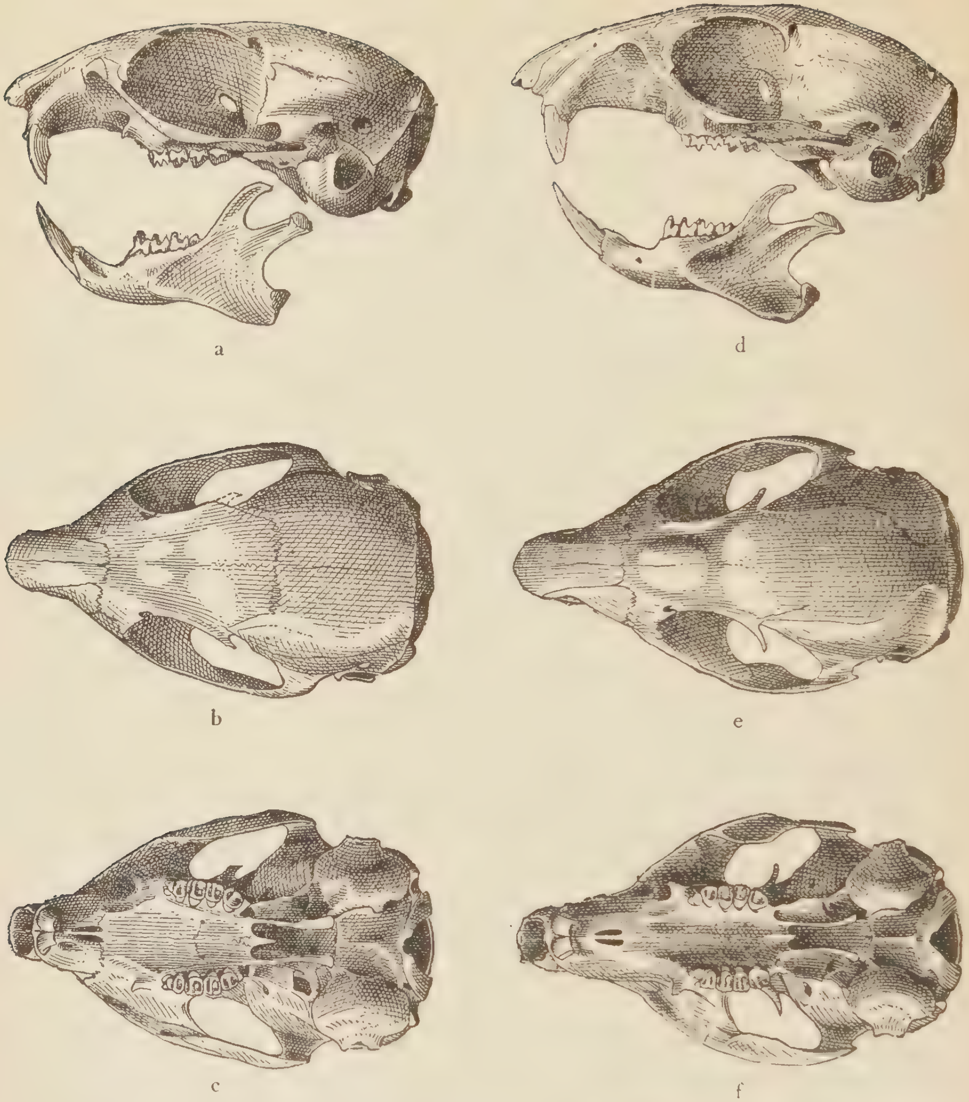


PLATE XXII. —SKULLS (a, b, c) SAY'S CHIPMUNK (*C. lateralis*); (d, e, f) 13-STRIPED CITELLUS (*C. 13-lineatus*)

These cuts are from Mearns's *Mammals of the Mexican Boundary*, supplied by the U. S. National Museum in the morning—and long before sunset, it retires for the night. On dull or cloudy days, it is scarcely seen at all.

Those that I kept in cages were put into a stupor by weather several degrees above freezing point, which temperature, however, did not affect the Yellow Ground-squirrel in the least. The latter may often be seen running wet-footed and chill-footed over the snowdrifts in spring time, but I never knew the Striped one guilty of such indiscretion.

The present species rises from its winter's sleep nearly two weeks later than the Yellow Squirrel, and retires in autumn about as much earlier, thereby losing a good month of active life.

Although very sensitive to cold, the Stripers are very tenacious of life, and it frequently happens that individuals trapped, crushed, or mangled and thrown aside for dead, have revived and escaped.

His Diet

Belonging to an order of herbivores, we expect to find this animal eating all things that grow above and below the ground—grass, herbage, seeds, berries, roots, and grain. But the creature is quite omnivorous, and habitually includes all garbage as well as herbage in its diet. I have known it to eat greasy house-scraps at which a Rabbit would have wabbled its nose in holy horror; as well as offal, insects, feathers, raw meat, small birds, Mice, and its fallen comrades.

The best available light on its food habits is found in Vernon Bailey's Report on the Ground-squirrels,[a] from which I chiefly compile the following records of its insect-, bird-, and reptile-eating propensities:

"They feed especially upon such insects as grasshoppers, beetles, caterpillars, and ants."

He quotes John N. Houghton, of Grinnell, Ia., as saying: "I have seen it catch and consume the cabbage butterfly repeatedly, and have also watched it digging for cut-worms."

At Ames, Ia., Prof. F. E. L. Beal "saw a Striped Spermophile with a large hairy caterpillar in its mouth."

The results of the examination of 22 stomachs of this Spermophile, made at Ames, Ia., are given by Prof. C. P. Gillette. "The animals from which the stomachs were taken were killed on various parts of the College farm, and at intervals from April 19 to August 2. As a result of this examination, it was found that insects formed 46 per cent. of the stomach contents, with an average number of 13 cut-worms and web-worms in each. 'The web-worms in these stomachs were, in the great majority of cases, the larvæ of *Crambus exsiccatus*, which is very injurious to corn and grass in Iowa, its work in corn being very often mistaken for that of cut-worms.' In conclusion, it is stated that 'the insects which the Squirrels feed on are almost exclusively injurious species, chief among which seem to be cut-worms, web-worms, and grasshoppers. As grass, clover, and other green stuff has been abundant wherever the Squirrels were taken, and as their stomachs were often gorged with insects that must have given them trouble to catch, it would seem that they prefer the latter food.'"[9]

---

[a] Prairie Ground-squirrels, pp. 35–45.

The only available record of the Ground-squirrel eating reptiles, is contributed by Bailey: "I once shot a Spermophile," he says,[10] "as it was sitting up eating something that it held in its paws. On picking it up, a partly devoured lizard (*Eumeces fasciatus*) was found, and several joints of the lizard's tail were in the Spermophile's cheek-pouches."

The step from reptile to bird is greater to the layman than it is to the naturalist or the Ground-squirrel. Horace G. Smith, Jr., of Denver, writes:[11] "I have found the feathers of the shore-lark (*Otocoris alpestris arenicola*) about the entrance to their burrows on one or two occasions; but whether killed by the Squirrel or not I do not know. . . . The shore-lark evidently regards them as enemies, for I have often seen them try to drive the Spermophiles from the locality of their nests, and have found the eggs of the species, as well as those of the lark-bunting (*Calamospiza melanocorys*), destroyed, as I suppose, by this Spermophile."

In the July of 1883, Miller Christy and I saw a Striped Ground-squirrel climb twice up a low, bushy spruce tree in pursuit of a vesper sparrow that was perched on top. Again in 1887, Christy wrote me from Shoal Lake: "May 18, I saw a kingbird chasing a Ground-squirrel (Striped) along the ground for some yards till it got into its hole. The bird kept at the business for (I should think) half a minute."

This seems to show that the kingbird recognized in the Ground-squirrel an enemy—one who was an habitual destroyer of small birds and their eggs.

As a Mouse and Chicken Killer

Those that I kept in cages invariably preferred raw meat to any vegetable food I could offer them. Prof. F. E. L. Beal states[12] that at Ames, Story County, Ia., he once saw one carrying a Field-mouse.

---

[9] Bull. Iowa Exp. Station, 1889, No. 6, p. 242, quoted by Bailey.

[10] Prairie Ground-squirrels, p. 39.

[11] As above, p. 38.

[12] As above, p. 39.

In a letter dated Lincoln, Neb., June 19, 1888, Prof. L. Bruner says[13] that he saw a Ground-squirrel "catch and kill a Fieldmouse, which is something I have never seen them do before. I do not know what caused the Gopher [Ground-squirrel] to do so, for as soon as I approached it, it dropped the Mouse and ran into its hole. The Mouse was badly bitten."

Kennicott writes:[14] "Dr. Hoy has shown that this animal feeds upon Mice and insects when in captivity; and he further informs me that he has examined burrows in which the numbers of the skins of Meadow-mice found, sufficiently proved the appetite exhibited by his caged specimens, to be natural. Those observed in captivity killed and devoured Mice in the same manner as the Weasel, showing themselves to be adepts in this mode of procuring food. One would spring upon a Mouse, savagely uttering a low snarl, and despatch it by biting its neck; after which the top of the skull was taken off, the brains licked out, and the blood sucked, the body not being devoured when there was an abundant supply."

Thus, the long, slender Weasel-like body of the species is not misfitting its character. This is, indeed, the Weasel of the family; and we wonder how the small ground-birds could raise a brood at all in the early days, when this bloodthirsty little creature abounded on the plains, and daily ransacked its home acre for the defenseless eggs or young of prairie birds.

Since the above was written, I have received the following, concerning this species: "Near Elk River, Minn., June 10, 1921, I heard a small brown leghorn chicken which seemed to be in pain; on going to investigate, I found it struggling to get away from something in a bunch of weeds. Just as I found it, it escaped, but only got two feet before I saw it caught again, and by a 'Striped Gopher.' I ran to the spot at once, but the chicken had been bitten under the wing, and was dead within half a minute after I arrived. The Ground-squirrel left the chicken as soon as it saw me. It was killed and proved to be an adult female in milk. The chicken was hatched May 23, 1921."[15]

Morris M. Green also describing the Striper as the commonest Squirrel of his district, Montmorency Co., Mich., says: "A number of young chickens were killed in a barn yard one night by some animal, so I was requested to catch a Weasel, the rumoured villain. Two steel traps baited with meat caught two of these Squirrels instead of a Weasel."[16]

---

[13] Prairie Ground-squirrels, p. 37.

[14] Quads. Ill., p. 78.

[15] Bernard Bailey, Journ. Mamm., May, 1923, p. 129.

[16] As above, Aug., 1925, pp. 175-76.

Nor does this sanguinary little rodent balk at the climax of a carnivorous life. As I have seen many times in cages, and as is attested by nearly all observers, it does not hesitate on occasion to kill and eat wife or brother, mother or child, when other opportunity is lacking to glut its appetite for the living flesh and blood. Thus, in spite of the strictly herbivorous teeth with which it is endowed, it is a logical presentation of flesh-eating, pushed to the unbridled conclusion.

FOOD SUMMARY

Vernon Bailey gives[17] this summary of his studies on its food habits:

"Eighty stomachs and eleven cheek-pouches were collected and their contents carefully examined. Since the stomachs were taken from specimens collected at various dates, ranging from May 19 to August 31, and over an extent of country including Minnesota, the Dakotas, Montana, Wyoming, Kansas, and Texas, it may be reasonably inferred that the average summer diet of the species is represented. Following is a list of the food components found in the stomachs:

Animal

Grasshoppers
Crickets
Caterpillars (larvæ of Lepidoptera)
Beetles
Ants
A small cocoon
Insects' eggs
Spermophile hairs
Feathers of small birds

Vegetable

Oats
Wheat
Pigweed (*Chenopodium*)
Bindweed seeds (*Polygonum*)
Wild sunflower seeds (*Helianthus*)
Nightshade berries (*Solanum*)
Cactus fruit (*Opuntia*)
Roots
Herbage

PREPARING FOR FAMINE

A surprising and delightful discretion is displayed by this animal in its selection of food for storage. *It never attempts to store food that will spoil.*

On this point, Bailey writes:[18] "The following tables show that the contents of the cheek-pouches differ widely from those of the stomachs, many things being eaten that are never stowed away in the pouches. For instance, more than half of the stomach contents consisted of insects, while no insects were found in the cheek-pouches, the latter invariably containing nothing but seeds. This is what might be expected, as the food laid up for winter is carried in the cheek-pouches."

---

[17] Prairie Ground-squirrels, p. 43.

[18] As above, p. 45.

Though storage is highly developed in the Ground-squirrel, the reason for it is not quite clear. The capacious cheek-pouches with which it is provided are in daily use *all through the season*. In illustration of this, and of their size and the owner's tastes, I quote from my Journal:

Carberry, Man., July 25, 1892. Collected a female Ground-squirrel that had in her cheek-pouches 34 grains of wild oats (*Stipa spartea*).

Morris M. Green writes of this species in Michigan: "One animal trapped had cheek-pouches bulging with 196 large seed pods of the sleepy catchfly (*Silene antirrhina*)."[19]

Concerning the storage of food, Kennicott states:[20] "This is done in spring and summer, as well as in autumn. Considerable stores of grain, seeds, roots, etc., are found thus collected in large side-chambers, excavated for their reception, in the burrow. Corn, wheat, and oats are stored up, when taken from the newly planted fields in the spring, with buckwheat and winter wheat later in the season; as well as heads of grain taken from the edges of the field in harvest time.

"I have seen more than a quart of crab-apples taken from the burrow of one which had carried them several rods from a tree. George and Frank Kennicott inform me that they observed one, the burrow of which was near a lone burr-oak, on the prairie, to carry great quantities of acorns into his hole; and another was killed by them, the cheek-pouches of which were crammed with the dry ovaries of a prairie plant, the seeds of which were exceedingly minute. From this, it would appear that the Striped Spermophile at all seasons carries portable articles of food to its burrow to be eaten. He certainly takes no food from the time he first becomes torpid, in autumn, until he again becomes active."

For what reason, then, does it store up all this food? We are forced to believe that it is done, not for winter use, but for the times during its active six months, when food is too scarce or the weather too bad, for it to forage successfully—that is, during the cold, wet spells in summer, unseasonable rains in autumn, and, above all, in early springtime. Confirmation of this is found in the following from my Carberry Journal of 1882; "May 2, I ploughed up the storehouse of a Striper. It contained two pints of wheat and one of buckwheat in separate piles."

---

[19] Journ. Mamm., Aug., 1925, p. 176.

[20] Quads. Ill., p. 77.

The species is, moreover, obliged to lay up more than it needs, to offset the pilferings of the parasitic Mice mentioned later.

NEVER DRINKS

So far as known, the Striper never drinks. As with many small rodents, the moisture of the vegetable food is sufficient for its needs; so that the story of the well or burrow running down to water is a myth. I kept a number of the Ground-squirrels of both kinds in a cage all summer; but they never paid any attention to the water supplied them, so we ceased providing it. A very hot spell continued for a week, and it was suggested that the Ground-squirrels might now enjoy a drink. A saucerful was put in. Four would not touch it, two sniffed at it, wetting their whiskers slightly, then licked the whiskers dry; but could scarcely be said to have drunk.

ITS FOES

Like the rest of the group, this animal is the accepted prey of all creatures, great and small, which prey. As Dr. Coues has pointed out in good set zoological terms, the proper function of the whole order Rodentia is to turn grass into meat for the sustenance of their betters. I have taken Striped Ground-squirrels from each and every kind of hawk that nests in Manitoba.

Among the quadrupeds, the Badger chiefly makes a special study of Ground-squirrel as diet. I have in many places seen the shelter burrows ripped open for 20 or 30 yards, showing where the Badger pursued the Squirrel by demolishing its rooftree; and usually there was some evidence to show that he had been successful.

PARASITES

Cats kill a great many Ground-squirrels, but do not thrive on them; in fact, many hundreds of Cats have died from feeding on such diet. The reason apparently is that the Squirrel is infested by abdominal and intestinal worms, which are taken by way of the Cat's stomach into its system, and there work their havoc.

These worms I have found in most Ground-squirrels, both Yellow and Striped, in the spring and early summer. The *Ixodes*, or tick, that infests Rabbits, I have not yet found on these species, but confidently look for it.

Another remarkable insect parasite is the *Cuterebra*, commonly called a "bot" or "warble." My attention was first directed to this in the August of 1882. On the 5th of that month, I wrote as follows: "Got a male Striper, apparently in good health, but the scrotum was entirely occupied by a large grub about one inch long and half an inch wide. It resembled a butterfly cocoon. The head projected outward toward the animal's rear. The testicles were either undeveloped or consumed, as there was no sign of them. The grub, when cut out, progressed over a board about as fast as an earthworm would, point first, i. e., the end that was inwards. It was of a light olive, thickly sprinkled with fine black spots. I am told that the Ground-squirrels have been found with their hind-quarters paralysed by one of these grubs."

This fly is very active in its attacks on the Ground-squirrel during late summer. In 1884, I made a careful investigation of its ravages. The following are the items from my Journal at Carberry:

July 26, 1884. Found a young Squirrel of the year with the larva of a cuterebra in the skin of its cheek; it had expanded so as to fill the cheek-pouch. This was the earliest observed.

Aug. 3. Caught 5 Stripers to-day; of these, 2 had had the warbles, but they were gone, and the places nearly healed. One, a female, was carrying a larva under the skin, between her hind legs, of all uncomfortable places.

Aug. 5. Collected 1 male; it had 1 larva.

Aug. 6. Collected 3 Stripers; each had a larva, although 2 were females.

Aug. 8. Out of the 5 Stripers taken to-day, 4 had the parasites, and 2 of these were females.

Aug. 12. Of 2 specimens, 1 only was infested, and it had two, one in each hind leg.

Aug. 14. Of 3 specimens taken, 2 had larvæ; 1 of these was a female.

Aug. 18. Captured a large male Striper. It had 1 larva, this in its scrotum. It was fully developed, and soon it crawled out of its cradle to be promptly devoured by its recent host, amid the applause of the spectators.

Aug. 20. Fired at a marsh hawk that was carrying a Striper. This was dropped; it proved a male. In its scrotum was 1 fully developed larva, which presently crawled out and escaped.

Aug. 25. Out of 4 specimens collected to-day, but 1 had had a larva. This host was a female.

Aug. 30. Out of 2 specimens to-day, 1 had had a larva, now escaped the host was a female.

Sept. 4. Collected 1 female Striper. She had 2 larvæ still in her belly skin.

Sept. 11. Collected 2 males, the last of the season—neither had any larvæ. The season is doubtless over for parasites as well as for host.

This record shows that the cuterebra infests males and females indifferently; but it generally, though not always, attacks the lower abdominal region, and is frequently housed in the scrotum of the male. But does it emasculate the host? It is usually credited with doing so. In my 1882 account of this parasite, I stated so, because the scrotum seemed quite empty after the grub was removed. In view of the fact that the testicles are reduced almost to nothing after the breeding season, possibly withdrawn into the body, I do not at present consider it proven that the cuterebra really emasculates the Striped Ground-squirrel or its larger cousin. (See also Gray-squirrel Life, p. 54.)

His Worst Enemy

There can be little doubt that the greatest enemy, the one alone which is wiping him off the ancient prairies, is the plough. In my Manitoba notes for June 7, 1892, I find this.

The natives say that the large Ground-squirrels kill the Striped species. I have seen no signs of actual encounter, except in cages, where the small ones were usually victorious, but it is quite evident that the former are overrunning the country. The farmers complain greatly of their ravages. . . . I have no doubt that the chief enemy of the smaller species is the plough. This Squirrels' home is the virgin sod; its burrows are so superficial and small that they are destroyed at once by the plough, whereas the large and deep burrows of *richardsoni* are affected at the entrance only by the overturning shear, and are easily cleared again by their owner. This is supported by the fact that, wherever you find a tract of dry virgin prairie left, you are sure to find it populated still by the Striped species, while the Yellow alone is found in the ploughed fields.

Last Days on Earth

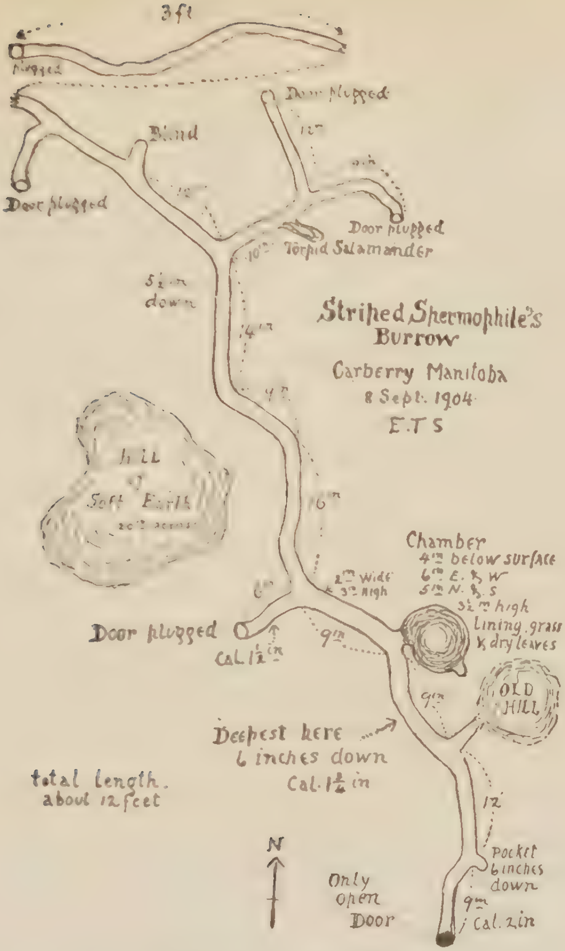
During August and early September, the Striped Ground-squirrels may be seen running into their holes with full loads of bedding and provender. There is some reason for believing that the wandering father returns in time to do his share of these preparations. Kennicott takes this view, and refers[21] to the "winter burrow, in which the pair hibernate, and the female brings forth her young."

During cold days now, they do not show themselves at all. About the middle of September, they bid good-bye to the sunlight, plug up the doorway, and curl up for their seven months' sleep below the line of the frost.

"Whether they remain dormant all of the six or seven months which

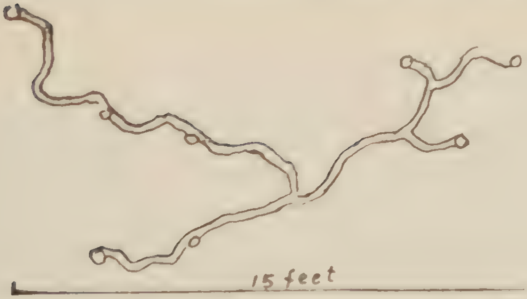
---

[21] Quads. Ill., p. 76.



Burrow of 13-striped Citelle

Drawn by E. T. Seton, Carberry, Man., Sept. 8, 1904



13-Striped Citelle's Playground, Manitoba, 1882

Burrow 2 or 3 inches below surface; 8 entrances. The fact that *all the entrances were open* is important in contrast with the plugging of the doorways to the home den

The larva of Cuterebra, secured Aug. 5, 1882, at Carberry, Man.

(Natural size)

PLATE XXIV.—13-STRIPED CITELLE—BURROW, ETC.

are spent underground, is difficult to determine," says Bailey,[22] "but it seems probable that they do not."

HIBERNATION

The only investigation of this creature's torpor, so far as I know, is by the late Dr. Philo Romayne Hoy, of Racine, Wis. He states:[23]

"The following are the results of many observations and experiments on the Striped Gopher (*Spermophilus tridecemlineatus*) during active life as well as when under the profound stupor of hibernation. During activity, the Gopher's pulse is 200, respiration 50, temperature 105.

"On the 2nd of October, having procured a Red-squirrel (*Sciurus hudsonicus*) and a Gopher, animals of nearly equal size, the one active during the coldest weather, while the other is a characteristic hibernator, I cut out a part of the gluteal muscles of each, and after dividing and bruising, so as thoroughly to break up every part, I took fifty grains of each and placed in a test tube, into which I put two ounces of cold water. After freely agitating, the mixture was left to digest for eight hours, at the expiration of which time I carefully decanted and renewed the water, agitated and left twelve hours, then filtered and rolled the residuum on blotting paper in order to remove all excess of moisture. When weighed, they stood: Gopher, 50–15; Squirrel, 50–10.

"These experiments were repeated with substantially the same results. Gluteal muscles of the Squirrel contained 20 per cent. of albumen, soluble in cold water, while the same muscles of the Striped Gopher treated in like manner, at the same time, yielded 30 per cent.

"As it is well known that the flesh of reptiles is rich in albumen, I procured several marsh frogs and subjected the gluteal muscles to like analysis, which resulted in 40 per cent. of loss. The following will convey to the eye these results:

"Per cent. of soluble albumen: Frog, 40; Gopher, 30; Squirrel, 20.

"On the 15th of December, the Gopher being thoroughly torpid, temperature of the room 45, Gopher rolled up like a ball, no visible evidence of life, I opened the abdomen and inserted the bulb of a thermometer, which indicated 58 degrees. I next turned back the sternum in such a manner as to expose the heart and lungs. The remarkable, congested condition of these organs first attracted my attention. In fact, it would appear as if the blood had all collected within the thorax.

---

[22] Prairie Ground-squirrels, pp. 34–35.

[23] Proc. Am. Ass. Adv. Sci., Aug., 1875, pp. 148–49; quoted in Bailey's Report, pp. 35–36.

"The pulsation of the heart was reduced to four each minute, the auricles would slowly and imperfectly contract, followed immediately by the ventricles. These slow pulsations of the heart occupied four seconds. There was no visible respiration, the lungs remaining almost entirely passive. The heart continued to pulsate without perceptible change for fifteen minutes, and then when raised from its position, it continued to pulsate for some time, being almost reptilian in this respect. During hibernation, the circulation is so feeble that when a limb is amputated, but a few drops of blood will slowly ooze from the fresh wound. The stomach and bowels [were] empty, and the body was enclosed in a thick adipose layer. I was not able to excite the least motion or contraction of the muscles in any way, even by pinching or cutting nerves, showing the most perfect condition of anæsthesia possible.

"During hibernation, the Gopher is not able to endure more than 6 degrees or 8 degrees of frost. The manifestations of life are so feebly performed that a few degrees below freezing is sufficient to convert apparent death into the reality.

"On the 10th of April, at which time the first Gopher appeared above ground, I repeated the experiment of the previous autumn. Body emaciated, hair dry and lifeless, flesh perceptibly less moist than it was in the fall. On subjecting the gluteal muscles to like treatment as in October, I was surprised to find only 18 per cent. of loss instead of the 30, as exhibited in the previous autumn.

"The large amount of soluble albumen found in the flesh of the Striped Gopher in the fall, and the lesser amount found after its protracted hibernation, go far to prove that albumen somehow fits the animal for its long sleep. Is it not probable that albumen is a stored-up magazine of elaborated nutrition, to be used when no food can be assimilated by the digestive organ?"

His Book Balance

Although the farmers generally wage war on the Ground-squirrels as enemies to the crops, the case is not so clear as they seem to think. There is so much to be said on the other side that it is usually nearly a balance. Kennicott, after long study of the latter, wrote:[24]

"There can be no doubt that Meadow-mice and insects are largely eaten by these animals whenever they can be obtained; and the high probability is that their good offices in the destruction of these, far more than counterbalances their occasional injury to cornfields. I doubt their being so very injurious in long-cultivated farms."

---

[24] Quads. Ill., p. 78.

From all accounts, Indian corn is the cereal to which the Striper is most destructive. In Manitoba, it does no harm to this crop for the excellent reason there is no such crop. It certainly works mischief in gardens, but it is often blamed for the doings of its two larger relatives. On the other hand, as shown, it destroys enormous numbers of noxious seeds, insects, and Mice, and it would be well if the bounty law against it were repealed. Such laws are now generally discredited in America, and the numbers of this Ground-squirrel in our country are too small to constitute a danger even if it were as much a grain-eater as some would have us believe.

REFERENCES

1857—Quadrupeds of Illinois, by Robert Kennicott, pp. 74-79.

1893—The Prairie Ground-squirrels or Spermophiles of the Mississippi Valley, by Vernon Bailey, U. S. Dept. Agri. Bull. 4; 70 pages, 4 maps, many observations on food and habits.

1914—The Striped Ground-squirrels of Colorado, by W. L. Burnett, 19 pages on economic value, etc.

LIFE LXXV—FRANKLIN GROUND-SQUIRREL

	PAGE
Names	250
Description: Size, Colour	250
Range and Haunts	251
Home Range and Numbers	251
Not Sociable but Gregarious	253
Spring Advent and Song	253
Den and Home Life	253
Speed and Gifts	254
Drink and Food	254
Possibly Migratory	256
Enemies	257
Good-night	257
References	257

Franklin Ground-squirrel, Franklin Spermophile or Citellus, Souslik, Scrub-gopher, Whistling Gopher, Gray Gopher, Gray-cheeked Spermophile; Gray Ground-squirrel, or Bushy-tailed Ground-squirrel, Whistling Squirrel, Prairie Squirrel, Scrub Citelle

Citellus franklinii (Sabine)

(L. *Citellus*, see *ante; franklinii*, in honour of Sir John Franklin, commander of the Overland Expedition, 1819–22, on which Dr. John Richardson discovered this species at Carlton House. He sent the first specimen to Sir Joseph Sabine, who named it)

Arcotmys franklinii SABINE, 1822, Trans. Linn. Soc., XIII, p. 587.
[*Citellus*] *franklini* TROUESSART, 1904, Catal. Mamm. viv. foss. suppl. p. 342.

TYPE LOCALITY—Near Carlton House, Saskatchewan

FRENCH CANADIAN, *la Citelle* or *l'Écureuil de Franklin.*
SAUTEAUX, *Me-séd-jee-dah-mó* (Big Squirrel).
YANKTON SIOUX, *Ho-tang.*

In addition to the generic characters, the Franklin Ground-squirrel has the following:

Size. Length, 14 in. (355 mm.); tail, 4½ in. (114 mm.); hind foot, 2 in. (51 mm.).

Colour. All above, yellowish brown, becoming dark slaty or bluish gray on the head, and paler on the sides, everywhere finely peppered with black, which on the rump faintly suggests bars. Eyelids, lips, and throat, edge of ear and all below, dull yellowish white. Tail, gray and peppered on both sides, bordered and tipped with white; at the end is a sub-terminal band of black; each hair is in about 7 sections, which are alternately black and white.

The sexes are alike in colour.

When seen in its native surroundings, this Ground-squirrel with its bushy tail looks much like an ordinary Gray-squirrel.

The species is remarkable in that it has not split up into any well-marked races.

Range and Haunts

The range of the Scrub Citelle is apparently the rich prairie region, but is really the wooded borderland of that region. In Manitoba, it is generally distributed throughout the western Alleghanian fauna, but is rare on the east side of lakes Manitoba and Winnipegosis, and I found no trace of it in the thick forests of Riding and Duck mountains. Map VII (p. 252) shows its distribution in the Province as I saw it. Doubtless, this will be greatly modified by further observations.

It is essentially a ground animal, frequenting the edges of thick, dry undergrowth near woodlands or along hedges. It is equally strange in dense forests and on open prairies.

Kennicott says:[1] "I have known this Spermophile to take refuge in a hollow tree, crowding up the hole like the Gray Rabbit. Mr. F. C. Sherman, of Chicago, informs me that he twice saw one, when pursued, climb five or six feet up the trellis work and vines at the side of a house." But these are exceptional cases.

Home Range and Numbers

The home locality of each individual is probably less than 100 yards across. The only evidence I have, aside from probabilities, is the fact that one or two are often found inhabiting a little thicket of less than a quarter of an acre, and they can usually be found within a very few yards of the same place.

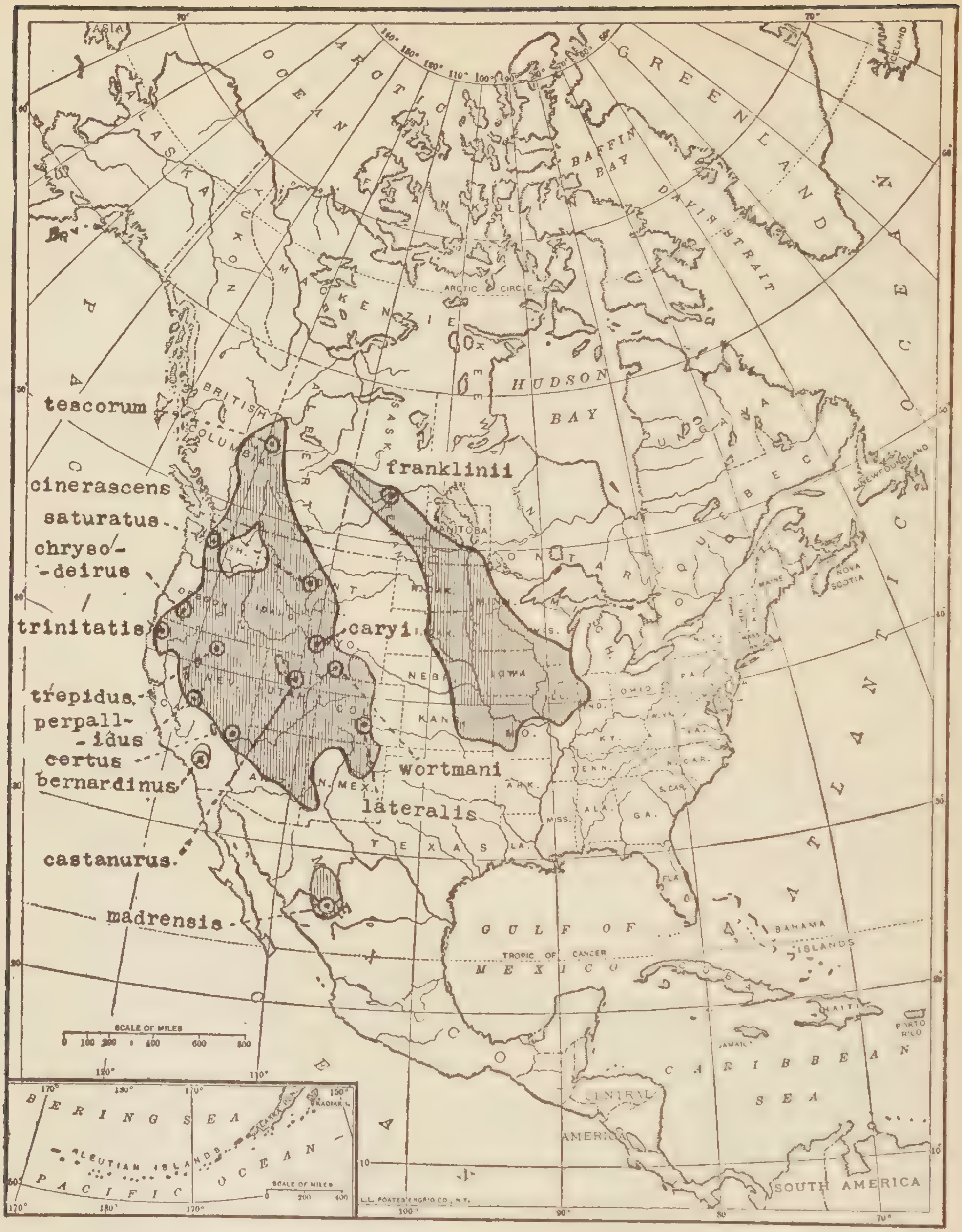
In 1882, we, in Manitoba, reckoned this the rarest of the Ground-squirrels. Since then, it has increased, especially about Pembina, Winnipeg, Portage la Prairie, Brandon, Minnedosa, and Dauphin, while the Striped Ground-squirrel has decreased; so that now (1909) this is much the more numerous of the two.

I should consider this species abundant if there were three pairs to every hundred yards square of scrub; and this is said to be under the probable population of the wooded borderland along the Red and Assiniboine rivers. At a place in Kansas (Auburn), where it was "very common," Prof. L. L. Dyche, says:[2] "On an average, I think there could not have been less than one Squirrel for each rod of fence."

---

[1] Quads. Ill., p. 80.

[2] Prairie Ground Squirrels, p. 53.



MAP VII.—RANGE OF SAY'S CHIPMUNK AND KIN, AND OF FRANKLIN CITELLUS
By E. T. Seton, with assistance of the Biological Survey, 1927

NOT SOCIABLE BUT GREGARIOUS

In Illinois, says Kennicott:[3] "It is usually found living alone or in pairs, and I have never observed a number of burrows scattered over a small prairie knoll like the semi-villages of the Striped Spermophile. This is perhaps owing to their small numbers; for the species appears to be naturally gregarious; and, at times, large companies live together, burrowing within a few feet of each other, and several pairs even entering the same hole."

SPRING ADVENT AND SONG

In its spring appearance, it is later even than the Striped species, and observers generally agree that it is about three weeks behind the Yellow Ground-squirrel. In Manitoba, therefore, it may be looked for ordinarily about the first of May; and in the regions to the southward at correspondingly earlier dates.

Most of the Ground-squirrels are noted for the great variety of the sounds they produce, but this is the musician of the family. It utters the same calls as the others, but expresses them in a fine, clear whistle. Its ordinary note heard in the brushwood, is in a high degree musical, resembling the voices of some of our fine bird-singers, and has won for the species the names of "Whistling Gopher" and "Musical Ground-squirrel."

Both sexes are supposed to make these sounds, but the point is not settled.

It has not been recorded uttering a spring chorus like that of the Eastern Chipmunk, and yet there is every reason to believe that it does.

DEN AND HOME-LIFE

The den is made in a low, brushy bank. In style, it is "usually deeper than that of the Striped Spermophile, but otherwise similar to it," says Kennicott.[4] Jillson says[5] that "when not frightened into their holes, they generally plug them up with dirt, but always leave them open when out." This habit has not been recorded by any other observer.

Dr. C. E. McChesney, of Fort Sisseton, N. D., credits[6] the species with nesting in a hollow tree.

---

[3] Quads. Ill., p. 79.

[4] As above, p. 80.

[5] Herrick's Mamm., Minn., 1892, p. 168.

[6] Mamm. Ft. Sisseton, Dak., 1878, p. 216.

The slight evidence at hand would set the mating season about the middle or third week of May, fully a month later than with the Yellow Ground-squirrel.

Kennicott is of the opinion that the species pairs, but that the male early abandons the female, and leads a solitary, roving life during the summer. Edwin Hollis says[7] of those that he saw at Touchwood Hills, Sask.; "Pairs of old ones and family seem to live together."

At Carberry, June 15, 1892, I got a female that carried 6 well-developed unborn young. A female in the New York Zoological Park produced 4 young on June 8, 1905. When I examined them on June 20, they were still blind, helpless, and nearly naked. Only the slightest beginning of hair was to be seen, but the colour that the coat was to be, was clearly shown in the tinting of the skin. One of them was 3¾ inches long, of which the tail was ¾ of an inch. The others were similar.

In number, they vary from 4 to 7. They are suckled for 5 or 6 weeks; and about the first of August, when about a third grown, they begin to come out of the holes and forage for themselves.

There is but one litter each season.

Although introduced to science in 1822, among the first of its group, less is known of its life history than of that of any of its kinsmen.

SPEED AND GIFTS

This handsome Ground-squirrel is the most active of the group. Even a terrier has little chance to catch it in its favourite undergrowth. It seems to know this very well, and will voice its shrill defiance again and again at the Dog in pursuit.

I once put a Gray Citelle into a cage with a Yellow Citelle that had been there for some time. At first, he seemed afraid of the big cousin, but soon plucked up courage enough to attack and defeat it. He frequently uttered his loud musical whistle, while the Yellow one did nothing but chatter its teeth.

DRINK AND FOOD

The next day, I offered this individual some water. It drank greedily and noisily, but not copiously. Thus, it differs from its two relatives in that it needs a supply of water. Perhaps this fact will be found important in defining its distribution.

---

[7] Collecting Small Mamm., in N. W. T. Canada, Zoologist, Aug. 15, 1902, p. 297.

The flesh-eating propensities of the group to which it belongs, are well known, and the Gray Ground-squirrel offers no exception to the family habit. It is less carnivorous than the Striped species, yet loses no chance to eat a meal of flesh. The one from which I made the drawing (Plate XXV) gnawed its way out of the cage one night, and ate the head off a newly mounted prairie-chicken before escaping for good.

"One observed by Dr. Hoy did not eat Mice, though it killed them when placed in its cage. Its food is generally similar to that of the Striped Spermophile, stores being also found in its burrow. It gnaws hard substances more than the Striped Spermophile, and while the latter will not gnaw out of a box, this readily does so. Caged specimens cut open hazelnuts also."[8]

Bailey says in his Ground-squirrel Report:[9] "At Pembina, N. D., I found several young Mice [*Peromyscus bairdi*] in the stomach of one of these Spermophiles; and at Ortonville, Minn., I shot one in the act of eating a freshly killed wood phœbe (*Contopus virens*). It had evidently just caught the bird, though it is difficult to understand how."

Speaking of the omnivorous habit of the species, Prof. C. L. Herrick says:[10] "During the summer it feeds upon wild fruits, such as strawberries, but has well marked carnivorous propensities. During a few days' encampment on Lake Traverse, several of these animals became so domestic as to partake freely of fish from our table so long as no suspiciously hasty motions were executed by the human participants."

Lawrence Bruner, of Lincoln, Neb., testifies[11] that in his State "it is carnivorous, at least when in captivity, as I can testify from experience with one I had caged during the greater part of one summer. After having been in a cage for about a month, I turned in a Mouse one day, in order to have a 'happy family' in my menagerie. Imagine my horror then to see Mr. Squirrel pounce upon the Mouse, kill and eat it in such a manner as to indicate that it was not the first Mouse thus eaten. The bones were held in the forefeet and stripped clean, after which they were dropped. The time occupied for the entire task of killing and eating the Mouse was not more than five minutes."

Finally, Herrick quotes Jillson as authority for the statement: "If a pair takes up its abode near small chickens and turkeys they soon thin them out."[12]

---

[8] Quads. Ill., p. 81.

[9] Prairie Ground-squirrels, p. 56.

[10] Mamm. Minn., p. 167.

[11] Prairie Ground-squirrels, p. 52.

[12] Mamm. Minn., p. 168.

In Manitoba also, this charge has been made against the Scrub Citelle. Indeed, it seems to be the only one of our rodents that is an habitual depredator of the chicken-yard.

Arthur M. Johnson supplies an incident which shows a disposition still more rampantly carnivorous. He was camping in northern Minnesota during August, and says:

"Our party had stopped for lunch in a vacant yard in the forest of western Aitkin County. Suddenly we heard sharp squeals coming from the edge of a copse, and looking in that direction we noticed what appeared to be a struggle going on in the grass. Hurrying to the spot, we discovered a nearly full-grown Gray Gopher struggling with a young Rabbit which it had seized behind the right ear. The Gopher hesitated a moment on our approach, but did not release its grip until I stepped to within a pace of it, when it darted off a distance of two or three feet. The Rabbit, I observed, was alive but unable to move. It was fully as large as the Gopher. We stood still and the Gopher returned to the attack, biting the Rabbit furiously about the body. Again I frightened the Gopher away, but it returned once more to the attack and repeated its previous performance. I frightened it away a third time, but again it returned and rushed upon the prey, biting it here and there about the body until it was apparently dead. Then, running its nose rapidly over the carcass, the Gopher began gnawing at the hind quarters.

"We left the scene, and about 20 minutes later, I returned to the spot, and found the Gopher still gnawing at the carcass, the hind quarters of which, except for skin and bones, had been devoured. Examining the spot where the struggle was first seen I found a small 'form,' in which the Rabbit had apparently been lying when it was pounced upon.

"A week or so previous to this occasion, at Gull Lake in Crow Wing County, I watched an individual of this same species making after a Striped Gopher, which, however, escaped into a brush-pile."[13]

POSSIBLY MIGRATORY

In a very limited sense, the species appears to be migratory. Kennicott, whose opportunities for studying it were unusual, says[14] that in Illinois "this Spermophile exhibits a remarkable disposition to migrate from one field to another. Not only do the males lead a wandering life in summer, but pairs appear frequently to change their quarters, leaving their winter burrow to breed in another, and then, perhaps, hibernating in a third, at some distance from this. In several instances, a company of a dozen or more have been observed to appear in a locality where none were seen the previous summer, and then to disappear after remaining there a year, or only a few weeks. In the early part of summer, 20 or 30 of these animals suddenly made their appearance, and burrowed in an old embankment, within three or four rods of my father's house. They seemed to have lost the shyness exhibited when leading a solitary life, and were not alarmed at the near approach of man. They even came about the kitchen door to pick up crumbs, and disputed with the chickens for their food. . . .

---

[13] Journ. Mamm., Aug., 1922, p. 187.

[14] Quads. Ill., pp. 79–80.

"A war of extermination was commenced. Several were shot, while others were killed with clubs, whereupon the survivors left in a body, as suddenly as they had come, and were never seen again, nor could they be found upon any part of the farm."

ENEMIES

In Manitoba, the principal enemy of the Gray Ground-squirrel is the red-tailed hawk. On July 9, 1884, I saw two of these hawks fighting over some prize. While they were so busied, I secured the booty, a fine specimen of this Ground-squirrel.

I doubt not, however, that all of the hawks and owls, as well as the Badger, Fox, Coyote, and Weasels take annual toll of the Scrub Citelle.

GOOD-NIGHT

Late in September, this child of the underbrush takes its last look at the sun, then barricades its doorway with earth against Weasels, wet, and frost, and sleeps until a half year later, when the white crane comes again and trumpets a resurrection to the underworld that slept as dead.

REFERENCES

1857—Quadrupeds of Illinois, by Robert Kennicott, pp. 79–81.
1892—Mammals of Minnesota, by C. L. Herrick, Geol. and Nat. Hist. Surv. Minn. Bull. 7, pp. 166–68.
1893—Prairie Ground-squirrels or Spermophiles of the Mississippi Valley, by Vernon Bailey, U. S. Dept. Agri., Bull. 4.

LIFE LXXVI THE FLICKERTAIL

	PAGE
Names	260
Description: Size, Weight, Colour	260
Range and Haunts	261
Teeming on Its Range	261
Spring Coming	264
Home Range	264
Sociability and Voice	265
Mating and Home Life	266
Powers and Way of Life	268
Bill of Fare	269
The Provident Wastrel	270
The Good He Does	270
Chemical Warfare	271
Enemies	271
A Brave Front	272
As Death-carrier	273
Cheating a Simpleton	274
The Chill Dark Days	274

Snaring the groundsquirrell.

THE SHORT CUT TO SCHOOL

Yellow Ground-squirrel, Yellow Prairie-squirrel, Yellow Gopher, Yellow Souslik, Canada Souslik, Big Ground-squirrel, Picket-pin, Flickertail, Richardson Ground-squirrel, Citellus, Citelle, Spermophile

Citellus richardsonii (Sabine)

(L. *Citellus*, see *ante; richardsonii*, in honour of Sir John Richardson, who discovered the species at Carlton House in 1820)

Arctomys richardsonii Sabine, 1822, Trans. Linn. Soc., XIII, p. 589.
[*Citellus*] *richardsoni* Trouessart, 1904, Catal. Mamm. viv. foss., suppl., p. 338.

Type Locality—Carlton House, Saskatchewan

French Canadian, *la Citelle ou l'Écureuil de Richardson.*
Cree and Ojibway, *Me-sed'-jee-dah-mó* (big Squirrel).
Ogallala Sioux, *Tash-nah-hay-hó-tah.*

In addition to the generic characters, set forth in the Life of the Striped species, the Yellow Ground-squirrel has the following:

Size. Length, about 12 in. (305 mm.); tail, 3½ in. (89 mm.); hind foot, 1¾ in. (44 mm.). Female is smaller.

Weight. The weight of a large male I found to be 13 ounces. Ebner gives weight in fall, 16 to 17½ ozs., in spring, 11 to 13.[1]

Colour. A Carberry specimen, a male taken Aug. 4th, doubtless typical, is, in general, of a warm yellowish buff, deepening along the cheeks, shoulders, flanks, and thighs to a strong buffy yellow. On the crown and back, it is thickly peppered with brownish black, giving the effect of a gray mantle. On the rump, these markings faintly suggest cross pencilling, or faint dapplings of lighter colour. The tail above is brown, peppered like the back; below, clear pale sienna; finished with a blackish edging, which again has a broad tipping of pale yellow. My specimens taken at Turtle Mountain, Man., late in April, are much paler in general colour, nearly white below.

The sexes are alike.

---

[1] Bailey, Mamm. N. D., N. A. F., 49, 1926, p. 58.

When seen alive, it is like a pale yellow Squirrel with a rather short tail, that it jerks and shakes upward every few seconds when watching an intruder. From this, it gets its name, Flickertail.

It has no recognized races, but it is closely akin to *elegans* of the Rocky Mountain region.

Range and Haunts

The Richardson Ground-squirrel is a characteristic inhabitant of the Saskatchewan Campestrian faunal area. In Manitoba, it is found on all the true prairies of the second steppe, as shown on Map. VIII (p. 262); but it enters also the upper part of the Red River Valley proper, along the east slope of the Pembina Mountain. At Morden, Man., I found it abundant, also thence northeastward as far as Myrtle. It extends in small numbers northward to Russell and the Gilbert Plains, on the west of Riding Mountain.

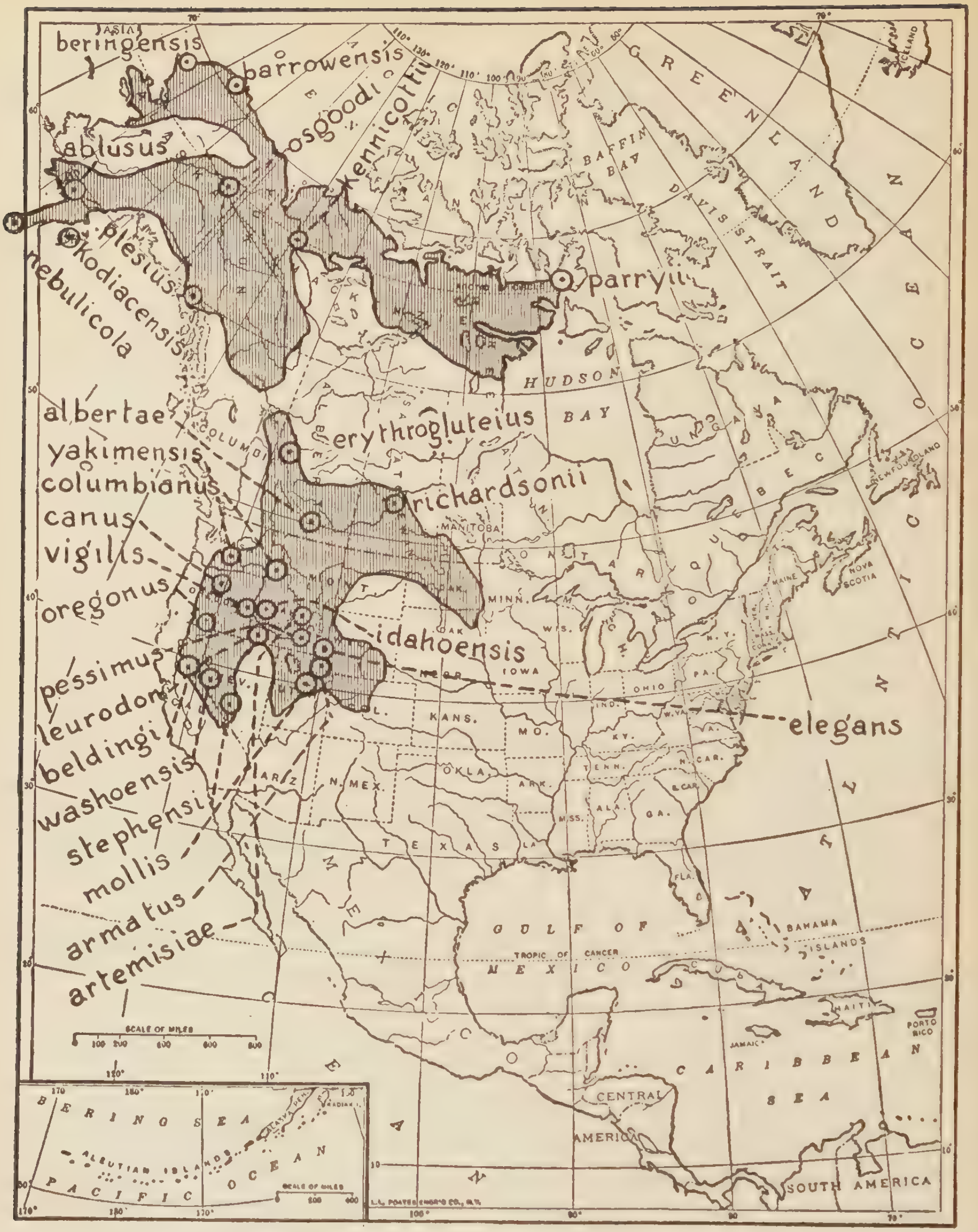
In the United States, it inhabits the north prairies from the Red River to the Rockies, chiefly north of latitude 45°.

This is strictly a prairie animal. It is never seen in or near the woods; its favourite localities are high rolling lands of stiff or gravelly clay; but prairie ridges of any kind are acceptable locations. It is as fond of cultivated fields as its Striped relative is of the virgin prairie. Its burrows are so deep that the plough does them no harm but what can be repaired in a few minutes, and the growing crop at the door affords bountiful forage; thus it fits in very comfortably with agricultural surroundings, and has greatly increased with the spread of farming.

In the Souris country, where there is abundance of wheat on rolling clay lands, it finds an ideal home, and is very plentiful.

Teeming on Its Range

This is by far the most abundant of the Ground-squirrels in the Northeast. At Whitewater, Man., on April 29, 1904, I examined an interesting colony of the species. In its centre of population, I marked off a space 10 yards by 20, then counted the burrows in it. There were 50. This, I should think, meant at least 25 adult Ground-squirrels in the space of less than one twenty-fourth of an acre. The colony straggled along for a mile or more, the population thinning out on the level fields to 4 or 5 holes per acre, and of course with none at all in the wet places. But taking all together, I calcu-



MAP VIII.—RANGE OF THE FLICKERTAIL

By E. T. Seton, with assistance of the Biological Survey, 1927

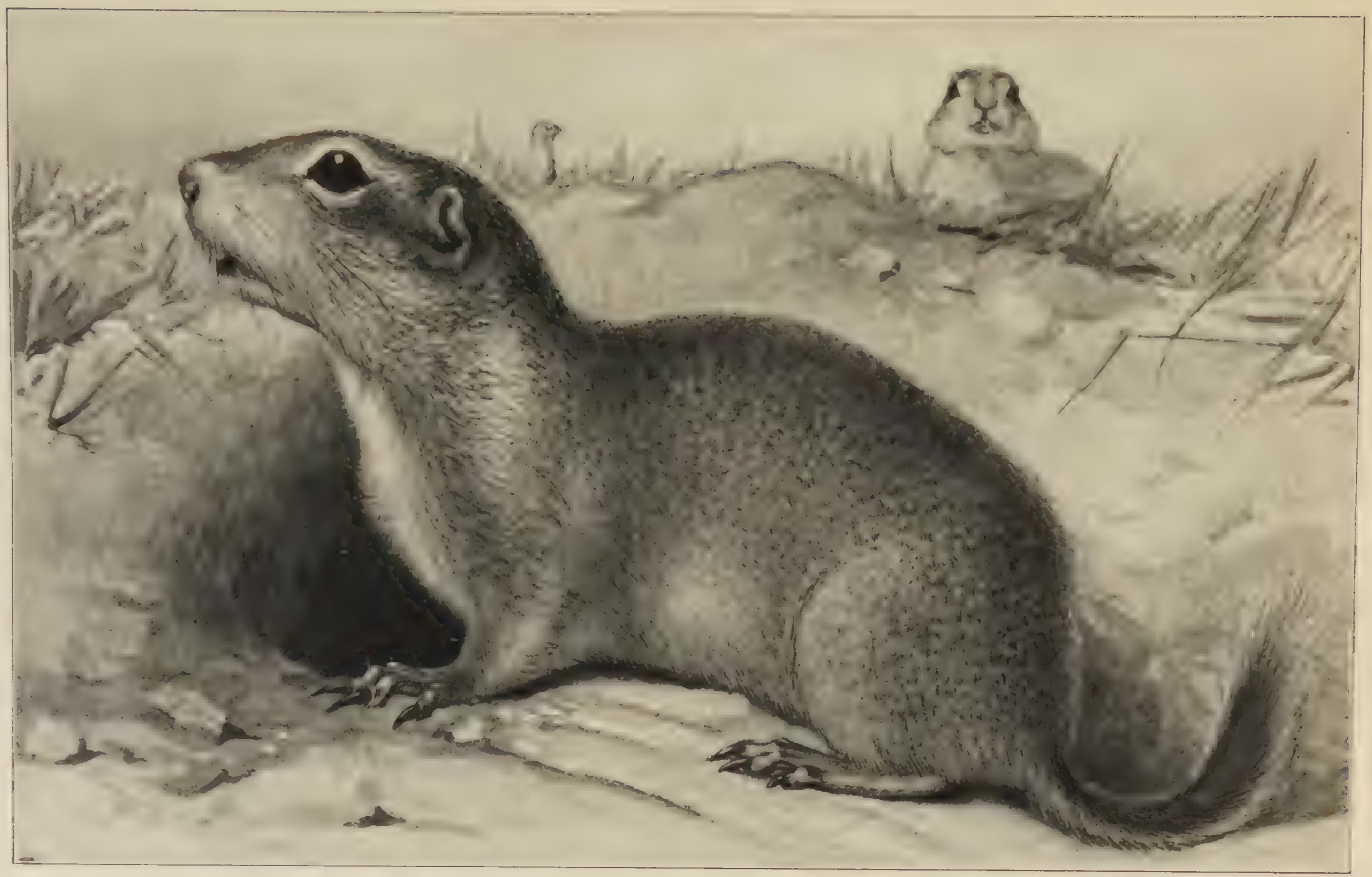


PLATE XXVI.—THE FLICKERTAIL OR RICHARDSON GROUND-SQUIRREL (ABOUT $\frac{2}{3}$ LIFE SIZE)

(*Citellus richardsoni* (Sabine))
Carberry, Manitoba, 1892
From drawing made by E. T. Seton, for Bailey, Bull. 4, 1893. U. S. Biological Survey, Dep. Agr.

PLATE XXVIII.—PRAIRIE-DOGS IN WASHINGTON ZOO

lated the Ground-squirrel population at not less than 10 per acre, or, say, 5,000 to the square mile. That 10 per acre is not too high is shown in a case observed on the Saskatchewan by James M. Macoun. A farmer there killed 300 of these Ground-squirrels on his field of less than 10 acres, and yet it made no obvious difference in their numbers.

In the Yellowstone Park, when I lived at Yancey's during the summer of 1897, I saw another species (*armatus*) so abundant that 10 might often be seen on a space 20 feet square.

Elmer T. Judd tells[2] of a square mile in North Dakota on which 4,000 Ground-squirrels were killed in one season. In one forenoon, Judd and a friend killed 135 on this section.

In a two-acre field of wheat at Carberry, Man., July 5, 1892, I counted 16 Ground-squirrels sitting up. I could not see those that were down on all-fours feeding, but it is safe to put them at double this number. There were at least 50 Ground-squirrels in that field, or 25 to the acre; and along the bank of Pollworth's slough, north of Carberry, in the early 80's, I have often seen as many as 50 Ground-squirrels within an acre, and there captured 20 in one hour with two traps. Even halving the lowest of these figures, we should have, at that time, a Ground-squirrel population of 20,000,000 on the prairies of Manitoba alone; which is a total area of 10,000 square miles. But the whole area of the Flickertails' range is 30 times this, so that 600,000,000 might be its total population in 1900.

That these estimates are not excessive is shown by the bounty records. At Carberry, in the year 1890, with bounties at 3 cents per tail, $1,180 was paid out. This represented 40,000 Ground-squirrels killed in the municipality of North Cypress (about 400 square miles), and yet there seemed to be just as many as before.

Coues has given us a bright pen picture of this creature along the Canadian Boundary Line. "It is one of the most abundant animals of our country," he says, "occurring by hundreds of thousands over as many square miles of territory, almost to the exclusion of other forms of mammalian life. Millions of acres of ground are honeycombed with its burrows. . . .I never saw any animals—not even Buffalo—in such profusion. I have ridden for days and weeks where they were continuously as numerous as Prairie-dogs are in their populous villages. Their numbers to the square mile are vastly greater than I ever ascertained those of *S. beecheyi*, the pest of California, to be, under the most favourable conditions."[3]

Such facts and figures show also how hopeless it is for man to fight these armies by actual onslaught; there is not money enough in the country to carry on such a warfare with success. The wiser plan is to work with other forces, those of nature and of careful science; and the credit of finding the way belongs to the Biological Survey of the United States Department of Agriculture. The Ground-squirrel had increased rapidly in numbers with the cultivation of the country throughout its range, until about 1894, when it became a serious burden to the farmers. Then was invented the scientific method of poisoning that has given us the upper hand once more, and made it easy to deal with the problem. (See later section.) Since then, the Ground-squirrel numbers have fallen below the danger point, though constant vigilance is still the price of good crops, as indeed it is of most good things.

---

[2] Bailey's Rep. Prairie Ground-squirrels, U. S. Dept. Agri., 1893, Bull. No. 4, p. 65.

[3] Am. Nat., IX, 1875, pp. 148–54. Quoted in Bailey's Report, p. 62.

Spring Coming

This species appears above ground very regularly each year about the middle of April, without regard to the weather. Late snowstorms sometimes set in after its reappearance, and the Ground-squirrel becomes unenviably visible as it runs over the white, but this does not make it return to its winter sleep.

On April 27, 1892, in Manitoba, an unprecedented snowstorm occurred, and covered the ground a foot deep. Next day, the Ground-squirrels were seen in thousands running about. So far from becoming scarce under the trying weather, they seemed rather to have increased; at least, they became unusually prominent.

In the mild season of 1905, however, A. S. Barton writes me that these winter-sleepers came out during February in the country about Boissevain, Man.

Having broken their sleep, they need food; but the natural supplies have not yet begun to grow, and starvation might be their lot had they not been careful to lay up a store the year before, when there was abundance in the land.

Thus April is the season for which chiefly they gathered the crop of the summer gone by, and the month is given over to love and feasting, without care for the food of to-morrow.

A number of specimens examined at the end of the month (April 27th and 28th) had their stomachs filled with the first appearing grass.

Home Range

The home region of each individual is doubtless very small. Probably, the creature never ventures a hundred yards from its own door; I doubt if it ever goes voluntarily fifty yards from the burrow. I have known individuals go over a hundred yards to a favourite food, but they do so under special provisions against surprise, as the following note illustrates:

Carberry, Man., July 5, 1892. As the sun lowered, it fast lengthened the shadows, and brought into prominence the smallest depressions on the prairie; it revealed also on a long bank by the 20-acre wheatfield a perfect labyrinth of Ground-squirrel runs (Plate XXVII, p. 267) leading from all parts of the near prairie for 100 yards or more into the grain. The runs had no common plan beyond convergence at the crop; but each main run appeared to have on it a sort of refuge burrow at every 10 or 15 yards. These refuges differed from the residential burrows in being small, inconspicuous, half-hidden in the run, and without mounds. The Ground-squirrels would dodge from one to another, twinkling in and out of sight at the slightest alarm. If two happened into the same burrow, there was mischief brewed at once, and the weaker had to make a dash across country in search of some more hospitable retreat.

Sociability and Voice

This is the most sociable of our three Ground-squirrels, as it commonly nests in straggling colonies, the members of which doubtless profit by each other's presence in learning of approaching danger; yet I never knew them to indulge in any sort of game or social pursuit, or attempt to combine their efforts for a common cause, except in the case narrated later in the section on A Brave Front (p. 272).

Nevertheless, as Coues says:[4] "Their gregarious instinct is rarely in abeyance. A few thousand will occupy a tract as thickly as the Prairie-dogs do, and then none but stragglers may be seen for a whole day's journey. . . .

"There is one very curious point in the socialism of these animals. Every now and then, in odd out-of-the-way places, where there may not be another Gopher for miles perhaps, we come upon a solitary individual guarding a well-used burrow, all alone in his glory. The several such animals I have shot all proved to be males; and what is singular, these old fellows are always larger than the average (some would weigh twice as much), peculiarly sleek and light-coloured, and enormously fat. The earlier ones I got I suspected to be a different species, so peculiar were they in many respects. I suppose they are surly old bachelors who have foresworn society for a life of indolent ease, though if I had found them oftener among their kind, I should have taken them for the Turks of the harem."

---

[4] Am. Nat., IX, 1875, pp. 148–54; quoted by Bailey, pp. 62–63.

The species utters a husky alarm whistle as soon as it scents danger, and the end of the tail is raised at each whistle; thus we have directive sounds and marks combined. Old plainsmen say that a Prairie-dog's voice is tied to its tail, because every time it lifts one it lifts the other, and when one stops, the other does. This is equally true of the present species.

Mating and Home Life

It is not known whether this rodent pairs, is polygamous, polyandrous, or promiscuous. The mating season is about the middle of April or before that. Francis Dickie writes me from Carberry that on April 21, 1905, he killed 11 Flickertails; of these 6 were females, 4 pregnant; the embryos very small except in one case, where they were each half an inch long.

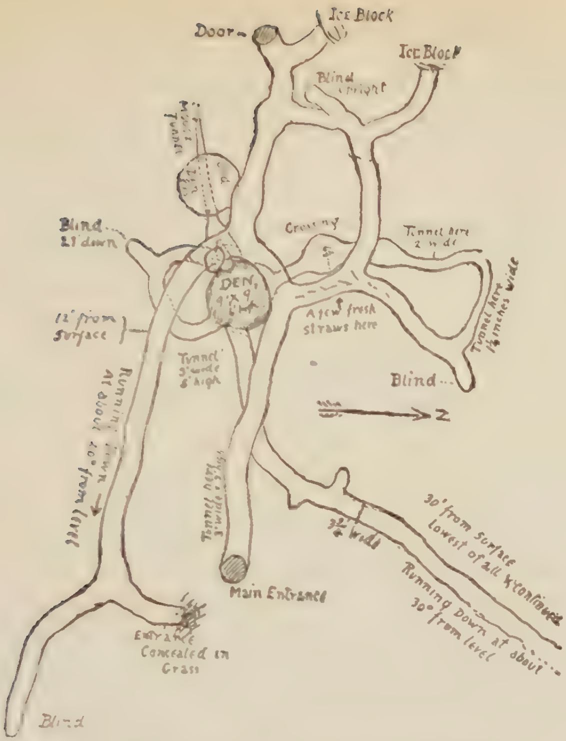
Three females taken April 29th showed embryos from the size of No. 4 shot ($\frac{3}{16}$ of an inch) to that of a bean ($\frac{7}{16}$ of an inch).

As the gestation of the Rat is 21 days, and that of the Rabbit 30 days, it is likely that the Ground-squirrel's period is between the two; therefore, the first of these embryos was in the second week of development, and the last within 10 days of birth.

At Whitewater, Man., on April 29, 1904, I examined the nest and burrow of a Yellow Ground-squirrel. This burrow was selected because I saw an old one run into it with a mouthful of grass. After four hours of hard work by myself and my assistant, E. W. Darbey, we dug out and made careful measurement of the labyrinth, plans of which are given in Plate XXVII (p. 267). We did not see anything more of the owner, so doubtless she escaped by some passage to another burrow, probably plugging the gallery behind her, as we missed it. This is the usual experience in digging after a burrowing animal. The grass she was carrying was found scattered along the outer gallery.

The small room marked "old den" had no connection with the burrow, so far as we could learn. It may have been an ancient chamber abandoned long before, as it was full of hoar frost and had no sign of occupancy. Two or three of the galleries were too small for the Squirrel to have made, and were probably the work of Mice. I am inclined to think that at least one species of Mouse is a parasite or commensal of these Ground-squirrels, inhabiting the small offshoot galleries. These they make from the tunnels of their host, and, tapping the store rooms, steal the provisions laid up by the larger rodent. In this case, we found a colony of *Microtus drummondi* not far from the burrow.

The chamber was 9 by 9 inches by 6 inches high, the lining, about two


Door
Ice Block
Ice Block
Blind upright
Blind 2½' down
Crossing
Tunnel here 2 wide
DEN, 9" x 9" 6" ht.
A few fresh straws here
12' from Surface
Tunnel here 1½ inches wide
Tunnel 3" wide 5" high
Blind
Z
Running down At about 20° from level
Tunnel here 3" wide x 3" high
3½" wide
30' from Surface lowest of all Kronfinger
Running Down at about 30° from level
Main Entrance
Entrance Concealed in Grass
Blind

Burrow of Richardson Ground-squirrel, Whitewater, Man., April 29, 1904 (Plan)

Runs of Richardson Ground-squirrel leading to a grain-field, Carberry, Man.
An asylum burrow is seen every 10 or 15 yards. The space shown is 30 yards each way

PLATE XXVII.—DETAILS OF BURROWS AND RUNS OF FLICKERTAIL

inches thick, was of grass and oat hulls and reaching well up the walls. I examined it carefully, and found no dung of owners or Mice, and no insects; it was thoroughly clean, but not dry or warm: I think it was not in use this year.

We found no nest in this. Evidently, it was too early for the family.

The burrow of the Yellow Ground-squirrel can always be distinguished from those of the other two by its size, having a calibre of about 3 inches; by the ever-increasing mound at the door; and by the fact that it rarely goes straight down, but is usually on a side bank and goes in at any angle; evidently, from the nature of the output, it reaches a considerable depth.

The young are born about the middle of May. Prenatal counting in eight cases showed the number to be 11, 7, 7, 7, 6, 6, 6, 6.

About the end of June, the young are one-third grown, and big enough to come out of the holes and make the acquaintance of the sunlight. They now look much like their parents, differing chiefly in being smaller.

Dr. G. B. Grinnell writes of the young as he saw them: "Years ago, in Montana, we watched two three-quarter grown Richardson's Ground-squirrels at play for some minutes at a distance of only a few yards. They were on the shelf of a flat block of weathered yellow sandstone in which there were several large cracks. They sat up on their hind legs, wrestled, pretended to bite necks and shoulders, and the one thrown down, when he fell, at once ran into a crack in the rock, to emerge a few seconds later and resume the game. We took it for granted then that this was a part of the sport, the defeated animal running away, and hiding for a moment to recover."[5]

At the entrance to each den, from one to ten of the Squirrels may be noted any bright day in late summer; and the scene in the colony is of the liveliest description. Birds and beasts of prey make the place a regular forage ground, and the farm boys come with trap and snare to earn a little bounty money. The growth of the young is rapid, and by September they are not to be distinguished from the old ones in activity or appearance.

POWERS AND WAY OF LIFE

When the thermometer is at 70 or 80 degrees, the Ground-squirrel is in its glory, but it has no liking for very hot weather. Whenever the temperature rises to or near the 90's, the Ground-squirrel hides below. It is, moreover, strictly diurnal; I never saw one above ground before sunrise or after sunset.

Although a winner in the ordinary struggle for existence, this animal has not the spirit of either of its cousins. Once I kept all three species—

---

[5] Forest & Stream, June 10, 1911, p. 899.

Yellow, Gray, and Striped—together in a cage; the Yellow Ground-squirrel, although the largest, was bullied by both of its relatives. It chattered its teeth angrily at them for a time, but finally submitted.

This creature is a poor runner. The farmer's boy can easily outrun it if he finds it far from its hole; and then it has to save its life by dodging—a hopeless shift, indeed, if the boy's usual four-footed colleague happens to be at hand.

In August, they may be seen all day running down their holes with pouches full of grain and other supplies. Sometimes these supplies are not food, but bedding.

Bill of Fare

In food habits, it is much less carnivorous than the other two species, and yet is omnivorous. Primarily, its diet is roots, leaves, and seeds of prairie plants.

Bailey says in this connection:[6] "Roots of plants are eaten and a great many seeds, especially those of pig-weeds (*Chenopodium album* and *boscianum*) and wild sunflowers, which are abundant and form a considerable part of the diet. They also eat grasshoppers and many other insects."

Dr. Coues tells, in his article already quoted, of the manner in which these little apostates of an herbivorous race would crowd joyfully around the carcass of a fallen Buffalo, as near and often as they dared, in view of the many strong creatures there assembled.

But the coming of the plough put a new complexion on their lives. The farmer killed the Buffalo and the prairie herbage. Very properly, then, the farmer is a lawful prey, and this Ground-squirrel easily heads the list of the four-footed pests who levy rack-rent tribute on the prairie ploughman of to-day.

In 1889, a law was passed providing a bounty of 3 cents to be paid for every squirrel tail delivered. The only tangible result was a depleted treasury. The Ground-squirrels continued to exact their tribute of many bushels per acre. Bailey considered that "the loss from ripe grain eaten, stored away or destroyed in autumn is small compared with that which they cause by digging up the seed after it is sown in the spring, as each kernel taken then deducts many-fold from the autumn yield."[7]

But they are mischievous throughout the season. Rollin C. Cooper writes Bailey that the species in North Dakota "is present in great numbers and very destructive to small grain, doing most damage after the grain begins to head out and shade the ground fully; they then pull down the grain and cut off the upper part of the stalk for many rods around their holes, seemingly to let sunlight strike the ground; they do not like damp places."[8]

---

[6] Prairie Ground-squirrels, 1893, p. 61.

[7] As above.

THE PROVIDENT WASTREL

It seems to be the habit of the species to carry food home in its cheek-pouches for immediate consumption as well as for winter stores. On May 23, 1884, I captured a Ground-squirrel from a very righteous hawk that had caught him raiding a grainfield, and had lynched him on the spot. This was a very large specimen, a male; it weighed 13 ounces. Its cheek-pouches contained 240 grains of wheat, and nearly 1,000 grains of wild buckwheat, which, however, is a noxious weed. Another, taken July 26th, had in its cheek-pouches 162 grains of oats. Bailey records one that had in its cheek-pouches 269 grains of oats.[9]

The ripening crops in August afford the Ground-squirrel a chance that it never neglects. Load after load of the golden grain is garnered into its own bin, some six feet underground. In October, the store is untouched and the owner sound asleep. I have but one personal observation in support of this. On Oct. 27, 1884, I followed a Badger track in about two inches of snow that had fallen the night before. The Badger had come to a Ground-squirrel's hole, and, guided, no doubt, by scent, dug straight down about six feet. The evidence showed that he had found and devoured the owners. Clearly, they had omitted to plug the doorway, and had paid the extreme penalty of their negligence, for there was the nicely made bed torn open. But also I saw there the storehouse containing about two quarts of wheat, all of it *sprouted*. Evidently, the Badger was not interested in wheat, as it was lying in piles, and there was as much in sight as apparently the little bin would have held.

The storehouses examined at Whitewater, Man., April 9, 1904, were empty.

So far as known, this animal is independent of water. It finds the moisture of its vegetable food sufficient.

THE GOOD HE DOES

The work that the various Ground-squirrels do for man as tillers of the soil is not to be forgotten, but it is small when compared with that done by the Pocket-gopher, and is more than offset by their destruction to standing grain.

---

[8] Prairie Ground-squirrels, 1893, p. 64.

[9] As above, p. 61.

The fur of this animal is used sometimes for cloak linings, but it is thin and poor. The leather has a possible application in the manufacture of "kid" gloves; but the skin is not usually considered of any commercial value.

Chemical Warfare

The safe and sure way to exterminate this farm and garden pest is by use of strychnine lethal dope, as recommended by the United States Biological Survey.[10]

An ounce of unholy strychnine boiled with benevolent starch syrup, spring water, and sundry chemics to take the place of toads'-eyes, efts' feet, etc., makes a hell-broth that, applied to 20 quarts of oats, yields a death feast for fifty fat frolickers. Which means you can extirpate the Flickertails on a hundred-acre farm for about a hundred cents.

Those whose losses are overpowering their scruples, can get full information by writing to the Survey for Form Bi-176, Jan., 1916.

Enemies

Every beast of prey from Bear to Weasel, all of the hawks, and some of the owls, prey on the Flickertail; and its only safety is a speedy retreat to Mother Earth—not by any means a bad plan, as is shown by results.

Prof. John Macoun tells me that 20 miles southwest of Saskatoon, Sask., July 29, 1906, he saw one of these Ground-squirrels sitting up on its mound as a Long-tailed Weasel came loping over the prairie. The Squirrel dived below; the Weasel went after it, but came out almost at once; evidently the Squirrel had fooled him.

But it has enemies that are even more dangerous. Five specimens collected May 2, 1884, were carefully examined. All were infested with wire-like worms in the stomach, alimentary canal, and scrotum. Nearly all spring specimens after this were found to be similarly infested.

The cuterebra or warble, too, is said to prey on this species, though I have not seen a case.

Since the appearance of the burrowing owl in Manitoba (about 1895) this Ground-squirrel has a new dependent; for its burrows are just such as are needed by the owl for nesting places; and unquestionably the baby Ground-squirrels are of just the right size, shape, and flavour to provide a delicious meal for the ungrateful bird.

---

[10] Ground-squirrel Circular, Jan., 1916.

A Brave Front

We have already noted that the Flickertail is gregarious, yet but slightly sociable. The grand exception is set forth in the following incidents that show the animals capable of uniting to repulse the common enemy.

J. Dewey Soper offers an incident of which I give a condensation. An old plainsman told him that once he watched a Prairie-weasel enter a Richardson Ground-squirrel colony when the majority of members were underground. The Weasel bounded about from mound to hollow and through the herbage, lithe as a reptile, nosing the ground like a hound.

Presently he saw a Flickertail that, unconscious of peril, was feeding at some distance from its burrow. But, sensing the danger, it wheeled and made a few frightened jumps toward home. The Weasel went eagerly at it. Realizing that it could not escape, the Flickertail sank back threateningly, chattering and screeching hoarsely with terror; the next breath, and the Weasel was on him.

But,. strange to tell, the relatives and neighbours of the Ground-squirrel shot out everywhere from their burrows, and in a wild mob, assailed the marauder. The chippering, champing, insane rabble was too much for the Weasel. He fought it for a while, but soon lost heart and fled, pursued for a few yards by the boldest of the mob.

The whole affair was over so quickly that the plainsman sat in the saddle, half bewildered. He could scarcely believe his eyes. As he rode away, he saw that the half-killed Flickertail had recovered, and presently limped down its hole.[11]

Ed. R. Warren furnishes a similar incident that came under his observation while camped in Yellowstone Park. The species in question was *armatus*, which is related to *richardsonii*.

"About five o'clock in the afternoon of August 2d," he says, "I was sitting at my table writing, and, happening to glance out of the door, I saw one of the Ground-squirrels chasing a half-grown Mountain Weasel (*Mustela arizonensis*), which seemed decidedly afraid of its pursuer. They came into sight from one side, the Squirrel but a few feet in the rear, and the Weasel dodged into a hole not far from my door. . . .

"It certainly seemed an extraordinary occurrence, and one which I surely never expected to see. One would think Weasels would be among the Squirrels' worst enemies, and that the latter would be in mortal fear of them.

"Several days later, Aug. 8th, I saw either the same Weasel or another of about the same size. Though there were several Ground-squirrels sitting up in the grass about the place, none of them seemed to be the least afraid of the Weasel, but went on unconcernedly with their feeding. One chased the Weasel a short distance, and once the latter came within a few inches of a Squirrel, which paid no attention to it. The Weasel seemed to be just playing about. It ran around in the grass here and there, and once I saw it roll and tumble over in the grass much as a young kitten or puppy would do. It ran off into the brush when I tried to approach it closely. . . .

---

[11] Canadian Field Naturalist, Sept., 1921, p. 106.

"Henry Lambert, an old-timer who made his headquarters at the camp, told me that he had once seen a Ground-squirrel chasing a full-grown Weasel on the prairie, and that the Weasel appeared to be doing its best to escape from the Squirrel."[12]

As Death-carrier

"The smaller the enemy, the more dangerous he is" might stand as an axiom in biology. The deadliest physical enemies of men are microbes; and next to them, insects. Man in America had no difficulty in protecting himself from the huge Grizzly, the huger Buffalo; but when he was confronted by the little Prairie-squirrels, the trouble became serious. When, further, the Prairie-squirrel appeared in conjunction with man's insect foes, the problem became acute. When, to this league, the lethal microbe was conjoined, it formed a woeful and unholy trinity against which it behooves mankind to rise and fight for their lives.

This very league is seen to-day in Montana. There the spotted fever has appeared—a deadly plague to man and beast—a fatal scourge.

Investigation by the Biological Survey shows that the fever germ is carried by ticks which, in turn, are nurtured and borne about by Ground-squirrels. Among those charged with this unwitting, wholesale dissemination of death is that brave little simpleton, the Flickertail.

Here is the Biological Survey's report on the spotted fever in relation to the Prairie-squirrels:

"It has been definitely ascertained that the fever ticks in the two younger stages live almost wholly on small native rodents. As the same rodents are responsible for extensive damage to crops in Montana and elsewhere, there are thus two important reasons for attempting their extermination, at least in the near vicinity of ranches. Here the ticks are readily transmitted to domestic animals, upon which they pass the later stages of their existence, when they are capable of transmitting the fever to human beings."[13]

---

[12] Journ. Mamm., Nov., 1924, pp. 265–66.

[13] Henry W. Henshaw, Ann. Rep. Dept. Agri., 1912, p. 6.

Commenting on this, Howell tells me that: "Spotted fever is unknown, however, on the Plains where this species ranges. *Citellus columbianus* is the species involved, and possibly *armatus*."

CHEATING A SIMPLETON

In trapping these brave, dull-witted creatures, but little subtlety is needed. If you walk gently toward a Ground-squirrel sitting at his front door, he gives a short, husky whistle about every ten seconds, jerks up his tail-end in time to his music, then takes the sub-soil plunge as you get nearer, going at 30 or 40 feet if you rush at him, but waiting till you are within 10 if you go slowly.

Now the ready trap is set at the door in plain view; neither bait nor covering is needed. In a minute, if all be still, the Ground-squirrel reappears, popping his head out cautiously once or twice, then boldly leaping out when he sees you at a safe distance. If he chances to overleap the trap this time, or step too lightly to spring it, a clod thrown at him sends him scurrying back in such heedless haste as is sure to land him in the disaster you have planned.

When a snare is used, it is set around the rim of the hole. The trapper now lies down some ten feet away, and jerks the noose as soon as the victim's head appears above the grass. It often helps to bring him out if you whistle softly. If, however, it be near sunset when he goes down below, you need not expect to see him out again that day.

I have many times driven a Flickertail gently into his hole, then sat down to wait beside it. His short whistle is invariably heard within, once or twice; then his nose reappears, only to drop back when he sees you. But he returns; and if you are still, he gets bolder, popping back and forth, probably; and though you be but three feet from the mouth, he will dodge out and scuttle away to the next burrow. It looks like a piece of daredevil bravado, for in many cases, there was reason to suppose he was owner of the hole he was leaving, and was not driven forth by any inhospitable relative.

THE CHILL DARK DAYS

Toward mid-September, as the days grow short and the mornings chilly, the Ground-squirrel comes out less often. By the end of the month, or at latest the middle of October, it says good-bye to the light upper world, and sinks, like the flowers, into the slumber that is to last until spring. For half of each year—half of its life—is spent in a sleep so deep that it is a temporary death.

LIFE LXXVII—THE PRAIRIE-DOG

PAGE
Names 276
Description: Size, Weight, Colour, Colour Freaks 276
Races 277
Range 278
Haunts and Home Range 278
His Billions 280
Numbers To-day 280
His Food 282
The War on Wistonwish 283
The Mound and the Plunge 284
His Home Tree 286
His Inter-burrow Subway 286
The Riddle 287
Preparing for Weather 287
In Case of Flood 288
The Den as a Home 289
His Way of Life 291
A Venerable Joke 292
Other Enemies 295
Who Buries His Dead? 296
Strange Habit Overdone 297
Good-bye 297

References 298

THE HAPPY FAMILY

Prairie-dog, Prairie Marmot, Barking Ground-squirrel, Barking Marmot, Prairie Barker, Louisiana Prairie-dog, Blacktailed Prairie-dog, Mound Yapper, Yap-rat, Wistonwish, Yek-Yek

Cynomys ludovicianus (Ord)

(Gr. *Kuon*, a Dog; *Mys*, a Mouse; L. *ludovicianus*, of Louisiana, the name once applied to all the unknown land west of the Mississippi)

Arctomys ludoviciana Ord, 1815, Guthrie's Geog., 2d Amer. Ed., II, pp. 292, 302.
Cynomys ludovicianus Baird, 1857, Mamm. N. A., p. 331.

Type Locality—Upper Missouri River

Mexican, *Tousa*.
Hopi, *Till-keha* (Mearns).
Dakota, *Ping-sping-sa* (Gilmore).

The genus *Cynomys* (Rafinesque, 1817) is composed of squirrel-like rodents of terrestrial habits. They have five distinct claws on each foot; rudimentary cheek-pouches; tail and ears very short; molars very large. Tooth formula as in *Citellus*.

In addition to the generic characters, the Prairie-dog has the following:

Size. Length, about 14¼ in. (362 mm.); tail, 3 in. (76 mm.); hind foot, 2⅜ in. (60 mm.).

Weight. A large ♂ that I secured Oct. 25, 1893, near Clayton, N. M., weighed 2 lbs. 14 oz.; a ♀ taken Jan. 16, 1894, weighed 1 lb. 12 oz. Hollister gives a Nebraska ♂ at 3 lbs.; ♀ 2 lbs. 4 oz.; a Montana ♀ at 2 lbs. 3 oz. All were taken in October.[1]

Colour. All above, reddish brown, pinkish, or grayish, finely lined with darker hair-tips; all below, pale buffy or whitish; eye-ring and muzzle, whitish; tail like the back, except that the terminal third is blackish with light tips to the long hairs.

At a short distance, it looks much like a very fat specimen of the Flicker-tail.

---

[1] Syst. Acct., p. 17.

Colour Freaks. It is remarkable that, in spite of the fact that melanos and albinos are of regular occurrence in most species of rodents, they are nearly unknown in the Prairie-dog. Perhaps an explanation will be found in the following:

A letter written by a woman naturalist, Julia S. Gilliss, is contributed by Dr. Elliott Coues. It relates the unhappy effect of a sombre coat on the fortunes of a Prairie-dog. This one, a coal-black and very large male, was brought in a cage, no one knew whence. He was turned loose among others of his kind in their normal brown. Five of them at once and furiously attacked "the poor little 'Fifteenth Amendment.'" He made a brave fight, but was driven into a hole from which he never came forth. The mob leaders carried scars for weeks afterward.[2]

RACES

ludovicianus Ord, the typical form. T. l., Upper Missouri River.

arizonensis Mearns, like *ludovicianus*, but larger and more brightly coloured. It has also well marked cranial differences. T. l., near Wilcox, Cochise Co., Ariz.

mexicanus Merriam, like *ludovicianus*, but larger, and of grayer colour; tail longer and with more black; teeth smaller. T. l., La Ventura, Coahuila, Mex.

Besides the foregoing, the Whitetailed or Shorttailed Prairie-dogs constitute an important group of two or more species. These, according to Hollister,[3] are as follows:

Cynomys leucurus Merriam, the Whitetailed Prairie-dog. Slightly smaller than *ludovicianus;* tail much shorter; general colour less reddish; supraorbital spot and cheek dark brown; terminal half of tail entirely white. T. l., Fort Bridger, Sweetwater Co., Wyo.

Cynomys parvidens Allen, the Utah Prairie-dog. Like *leucurus*, but smaller; upper parts much more reddish; skull smaller. T. l., Buckskin Valley, Iron Co., Utah.

Cynomys gunnisoni (Baird), Gunnison Prairie-dog. Much like *leucurus*, but darker and grayer; cheek spots dim; tail with only tip and edging white; also a subterminal band of black. T. l., Cochetopa Pass, Saguache Co., Colo.

---

[2] Pet Prairie-dogs, p. 245.

[3] Syst. Acct., pp. 24, ff.

C. g. zuniensis Hollister. This race is slightly larger than *gunnisoni*, with larger hind foot and heavier skull; colouration less buff and blackish; more pinkish cinnamon and ochraceous. T. l., Wingate, McKinley Co., N. M.

While these are rated as full species, and quite distinct from the Black-tailed group, the habits of all are somewhat alike, and this account of the Louisiana Prairie-dog will, at least, furnish a starting point in investigating the others.

RANGE

As with the Antelope, the Prairie-dog's Eastern limit was near the ever-significant 100th meridian; for this was the edge of the high Plains. Its extension on the north, east, and south, closely coincides with the Upper Sonoran fauna. In the mountains, where it seems to enter the Transition Zone, it has been turned into the species of the other group.

L. B. Potter, of Eastend, Saskatchewan, assures me that he has reliable information of its occurrence in the extreme southwest of the Province near Valmarie, south of Shaunavon.

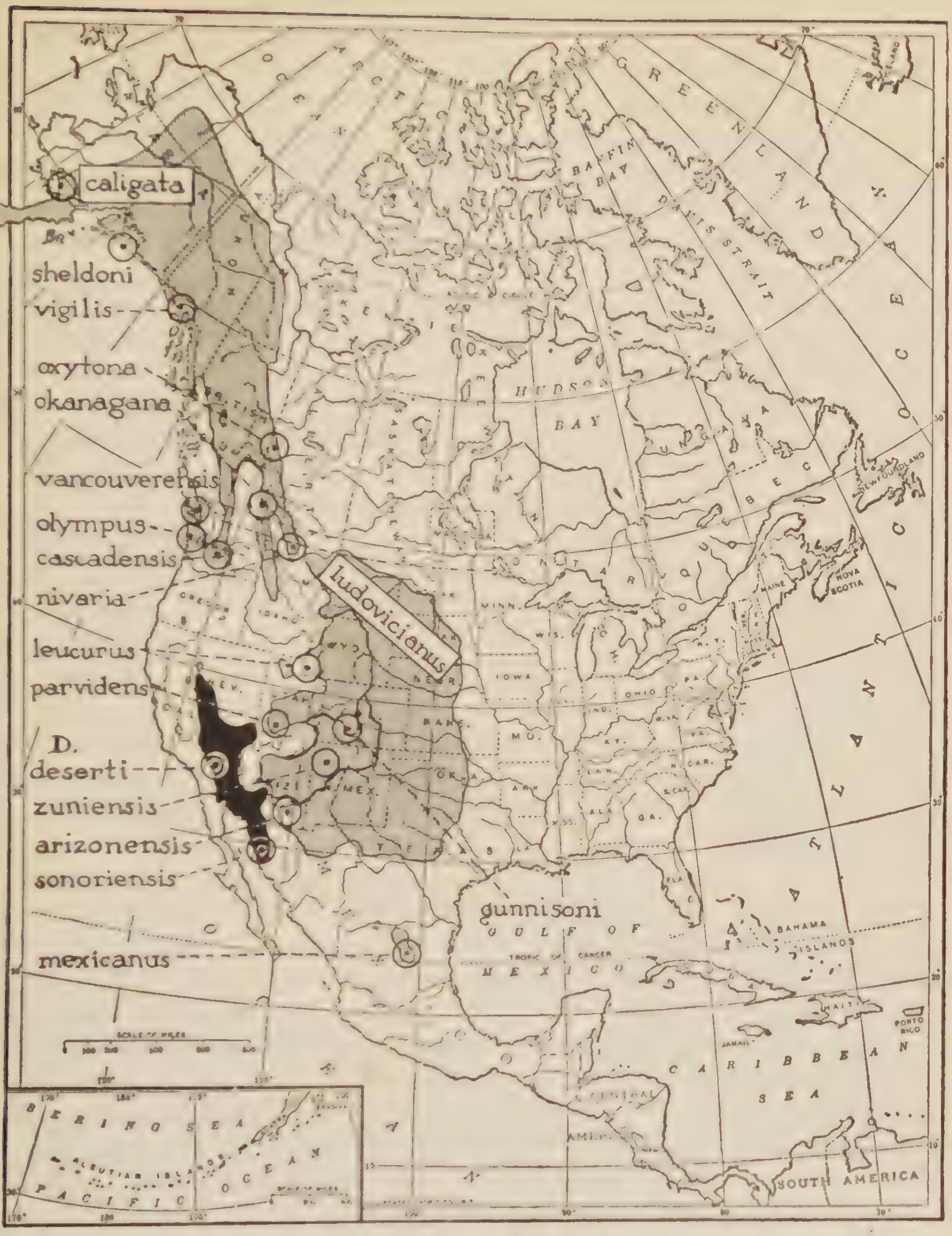
HAUNTS AND HOME RANGE

The haunts of the Black-tailed group are level, open, dry, clay country, either wide plains or flat valley lands. This Barker, as much as the Antelope, is a creature of the wide open spaces.

On the other hand, the White-tailed Prairie-dog's special domain is the Rocky Mountain region of the United States. They show a liking for rough surroundings—canyons, mesas, ridges, scrubby and rocky places, rarely below the 6,000-foot level.

So far as I could see or learn, a Prairie-dog never goes a hundred yards from home. His life is spent in his own front yard, a skimp half-acre.

This exception, however, must be recorded. Once in a while, for reasons not set forth by anyone or understood, and yet most obviously satisfactory, the whole population of a dog-town has been known to get up some fine day, forsake home, household effects, land and native ridge, then emigrate to parts unknown, some miles away. All of us who rode the Plains in the old days of the West, can recall the abandoned dog-towns that frequently were met with. Sometimes it seemed that the petering out of the food supply imposed this going. But on some occasions, this was evidently not the case; and guessing at the cause, we talked of rattlesnakes, Blackfooted Ferrets, changing water tables, and disease; yet without reaching any conclusion.



MAP IX.—RANGE OF THE HOARY MARMOT, OF THE PRAIRIE-DOG, AND OF THE KANGAROO-RAT

By E. T. Seton, with assistance of the Biological Survey, 1927

His Billions

If you go to the National Zoo at Washington, D. C., you will see some 50 Prairie-dogs living happily in a space about 30 ft. x 60. In this, they have 32 holes, 24 of which are obviously in use. This may be more congested than in native surroundings, and yet they seem no more numerous than I have seen them in the thickly populated parts of a dog-town; and would imply a rate of 1,200 to the acre.

Nevertheless, the Biological Survey experts—in a spirit of conservatism —set the Prairie-dogs in an ordinary town at 25 to the acre. And Bailey, writing of those he saw in Texas, says:

"Over an extensive area lying just east of the Staked Plains, they cover the whole country in an almost continuous and thickly inhabited dog-town, extending from San Angelo north to Clarendon in a strip approximately 100 miles wide by 250 miles long. Adding to this area of about 25,000 square miles the other areas occupied by them, they cover approximately 90,000 square miles of the State, wholly within the grazing district. It has been roughly estimated that the 25,000 square mile colony contains 400,000,000 Prairie-dogs.[4] If the remaining 65,000 square miles of their scattered range in the State contains, as seems probable, an equal number, the State of Texas supports 800,000,000 Prairie-dogs."[5]

The entire range of this species is over 600,000 square miles; so that, allowing for areas of lower rates in population, we probably had in round numbers 5,000,000,000 of the Blacktailed species alone during the latter part of last century.

Numbers To-day

In ancient days, the many four-footed, winged, and reptilian foes of Wistonwish kept his numbers down to the prescribed and paltry billions.

The Indian also preyed on him. The Barker furnished the favourite training in hunting, stalking, and shooting for the little redskins when first they were able to toddle threescore paces from the camp, and draw the tiny bow their fond parents had made and painted for them. When transfixed by the arrow, and so prevented dropping down his plunge hole, the Prairie-dog's fat body formed the fit and luscious feast on the young warriors' triumphant return.

Even this superadded drain was not enough to count; but when the all-destroying white man came to destroy the destroyers, he courted disaster for himself; for the fat, pot-bellied Barkers with their decimators gone, were multiplied and spread to possess the earth.

---

[4] Yearbook, U. S. Dept. Agri., 1901, p. 258.

[5] Texas, p. 90.

In comment, Merriam writes in 1901: "On many parts of the Plains, Prairie-dogs are now more abundant than formerly, and their colonies have overspread extensive areas previously unoccupied. This is due to the coming of the white man, whose presence favours their multiplication in two ways: (1) by increasing the food supply, and (2) by decreasing the animal's natural enemies.

"The white man cultivates the soil, and thus enables it to support a larger number of animals than formerly; at the same time he wages warfare against the Coyotes, Badgers, hawks, owls, snakes, and other predatory animals which had previously held the Prairie-dogs in check. Thus favoured, the Prairie-dogs have multiplied until they have become one of the most pernicious enemies to agriculture. . . .

"Richard Harrison, of Blunt, S. D., states that 10 years ago, there were possibly 25 occupied burrows on his land; the animals increased slowly; and 6 years ago, not more than 10 acres were infested. Since then, the increase has been so rapid that at present, the area they occupy covers about 160 acres.

"O. E. McArthur, also of Blunt, S. D., states that, about 15 years ago his children noticed two or three burrows about a mile from his house, and that no particular attention was paid to the inmates, which, during the next few years, increased slowly. A little later, however, they spread over so much land that their multiplication became a matter for serious alarm. At present, they occupy a full quarter section (160 acres), having surrounded Mr. McArthur's house and taken possession of all the land near it.

"A Cattle ranch in Logan County, Kansas, which 10 years ago pastured a thousand head of Cattle, will barely support 500 at present, owing to the great increase in Prairie-dogs, which have overrun the range. Practically the whole of the southern half of Logan County, is now one continuous dog town, estimated to cover about 300 square miles. In the past decade, the population of this area has decreased, a post-office (Elkader) has been abolished, and many homes have been vacated—the result, it is said, of the great increase in Prairie-dogs.

"At Carlsbad, in the Pecos Valley, N. M., in September, 1901, Vernon Bailey studied a colony of Prairie-dogs which completely covered a 20-acre alfalfa field, 4 or 5 acres in each of two adjoining fields, and several acres of prairie. He was told that this large colony had spread in three years from a small one in a corner of the alfalfa field.

"E. W. Nelson states that when he and his brother located ranches in a mountain valley in eastern Arizona in 1884, the only Prairie-dogs in the vicinity were a colony 3 miles distant, inaccessible except by way of a narrow box canyon. About three years later, a Prairie-dog's burrow was found on the ranch, after which the animals multiplied steadily, until in 1895 they occupied a large part of the Valley."[6]

His Food

In primitive days, the barking Mound-builder fed on nearly every form of vegetation native to the Plains. Maybe in the far Southwest, he shunned the creosote bush, and at all times he had little relish for the greasewood and the sage. Yet we know from the way in which he cleared off all plant life in his town, that green growth of any kind was dog-fodder.

Imagine his luck, then, when man destroyed the Buffalo, his principal rival for the grama grasses; then amplified the pastures with new and luscious things, such as alfalfa, grains, fruit, and garden truck.

Since man has arrogated to himself exclusive use of Nature's bounties as well as of such things as he himself has brought, we can realize the clash between the new settlers and these oldest inhabitants—a clash in which no kindly consideration is begotten of the Barker's readiness to vary his diet with grasshoppers and many noxious bugs.

In greater detail, here are some of the charges against him:

"He will cut down all the hay or grain around his burrow," says Burnett, "sometimes to the extent of half an acre, and leave most of it on the ground. The purpose of cutting down this vegetation which grows about their burrows, of which the greater part is never used, is, no doubt, to give them a better view of approaching enemies.

"They destroy pastures of native grasses, alfalfa fields, small grain, and corn and squash seed by digging it up after being planted. The writer visited a small cornfield (6 acres) near Delta, spring of 1915, where the Prairie-dogs had come off the hillside and destroyed three acres by following down the rows, and digging up every hill on the side where they entered the field.

"In some sections of eastern Colorado, they are very destructive to sorghum. They dig up beans and potatoes, eat into the sides of cantaloupes and watermelons to get the seeds, and burrow down to the roots of peach, apple, and pear trees, and in some sections attack the bark of trees above ground.

"According to government experts, 32 Prairie-dogs consume as much grass as one Sheep, and 256 Prairie-dogs as much as one Cow. These figures are for pasture land only. The injury done to the cultivated fields is much greater, on account of the value of the crop.

---

[6] Prairie-dog Great Plains, pp. 263–64.

"Where Prairie-dogs are abundant, the estimated number per acre is 25. . . . We will say that half your quarter-section is badly infested with Dogs. According to the estimate, you would have 2,000 Dogs, that will consume very nearly as much as 8 head of cows."[7]

The 800,000,000 accredited to Texas would, by these standards, "require as much grass as 3,125,000 Cattle,"[8] that is, they are robbing Texas of so much Cattle support, or, by induction, of so many Cattle.

"The total loss from the native rodent pests in the United States is estimated to be approximately $300,000,000 annually, of which one-half, or $150,000,000, is loss on the range due to forage destruction."[9]

Such losses have naturally resulted in bitter extirpatory war against the Prairie-dog.

THE WAR ON WISTONWISH

It is not my purpose to describe the Prairie-dog war which began about 1880, and has raged till now.

During the first 20 years, the Barkers could scoff at our best efforts. Their numbers increased, and their territory was widened. Arrows, guns, traps, and Dogs were annoying trifles. But when the wise men of the Biological Survey came on the scene with their poison gas and deadly dopes the tide of battle turned; and one by one, the dog-towns with their teeming, chippering pot-bellies, were left silent, and turned into irrigated fields and farms.

Those who wish to know the details, or claim help by these methods, are referred to the Biological Survey, Department of Agriculture, Washington, D. C.

As illustration of the simplicity, cheapness, and effectiveness of the war with gas, the following will serve: A 320-acre plot in Arizona was treated at a cost of $9.79; one man in one day did the work; 1,641 Prairie-dogs were killed and secured. Those that died in their holes easily raised the number to 2,000. The cost was less than 5cts. per 100 Dogs.[10] The pasture salvaged was enough to support 8 head of Cattle.

---

[7] Prairie-dog in Colo., p. 9.

[8] Bailey, Texas, p. 90.

[9] A. K. Fisher, The Producer, Aug., 1919, p. 8.

[10] Ann. Rep. Dept. Agri., 1918, p. 4.

The Mound and the Plunge

Like every creature on this list that has been able to hold its own against man, the Yap-rat's safety is in Mother Earth.

When first one sees a dog-town on the plain, the obvious and distinctive feature is the earth mound at the door of each den. Usually this is about a foot high, and 3 or 4 feet in diameter; but the "mound increases in size with age, those that have been used for many years attaining a height of 1½ or 2 feet, and a diameter of 8 or 10 feet."[11]

In the centre of the mound is the burrow. It goes very nearly straight down; that is, *every Prairie-dog's burrow is a plunge hole*—a sheer drop for rapid escape from danger.

This main hole is generally 4½ inches in diameter after it has left the funnel and narrowed to its normal calibre.

While one burrow to one mound is the rule, Mearns remarks of those he saw in Arizona: "A good many occupied burrows had no mounds whatever around them. I saw 3 adults enter a single burrow." Also, "there are often several burrows in each mound."[12] These, however, are abnormalities.

On examination, the hillock is found to have less the character of a mound than of a crater; and the more one observes these craters, the more evidence of plan and purpose is discovered.

While first and fundamentally a pile of clay, raked up somehow from below, it ultimately assumes the form of a hollow tower, that is deliberately built up and repaired each year, as a wall around the tunnel, to ward off floods; and as a high lookout.

The earth supply from below ceases as soon as the burrow is finished. Now the Prairie-dog gathers what he needs on the surface from many feet around, to perfect the architecture of his hollow tower—his safety from the menacing floods.

Every plainsman can recall how carefully each fall the Prairie-dog inspects and repairs the crater, in anticipation of the coming flood-time, just as a mill-man inspects his dams, or a Hollander his dikes.

Merriam writes concerning the clay wall: "This is pressed into form by the nose of the animal; [it] shows prints of the nose all around the inside. After injury from rains or other causes, the rim is repaired by scraping up the ground from outside."[13]

---

[11] Merriam, Prairie-dog, Great Plains, p. 260.

[12] Mamm. Mex. Bd., 1907, pp. 342–43.

[13] Prairie-dog, Great Plains, p. 260.

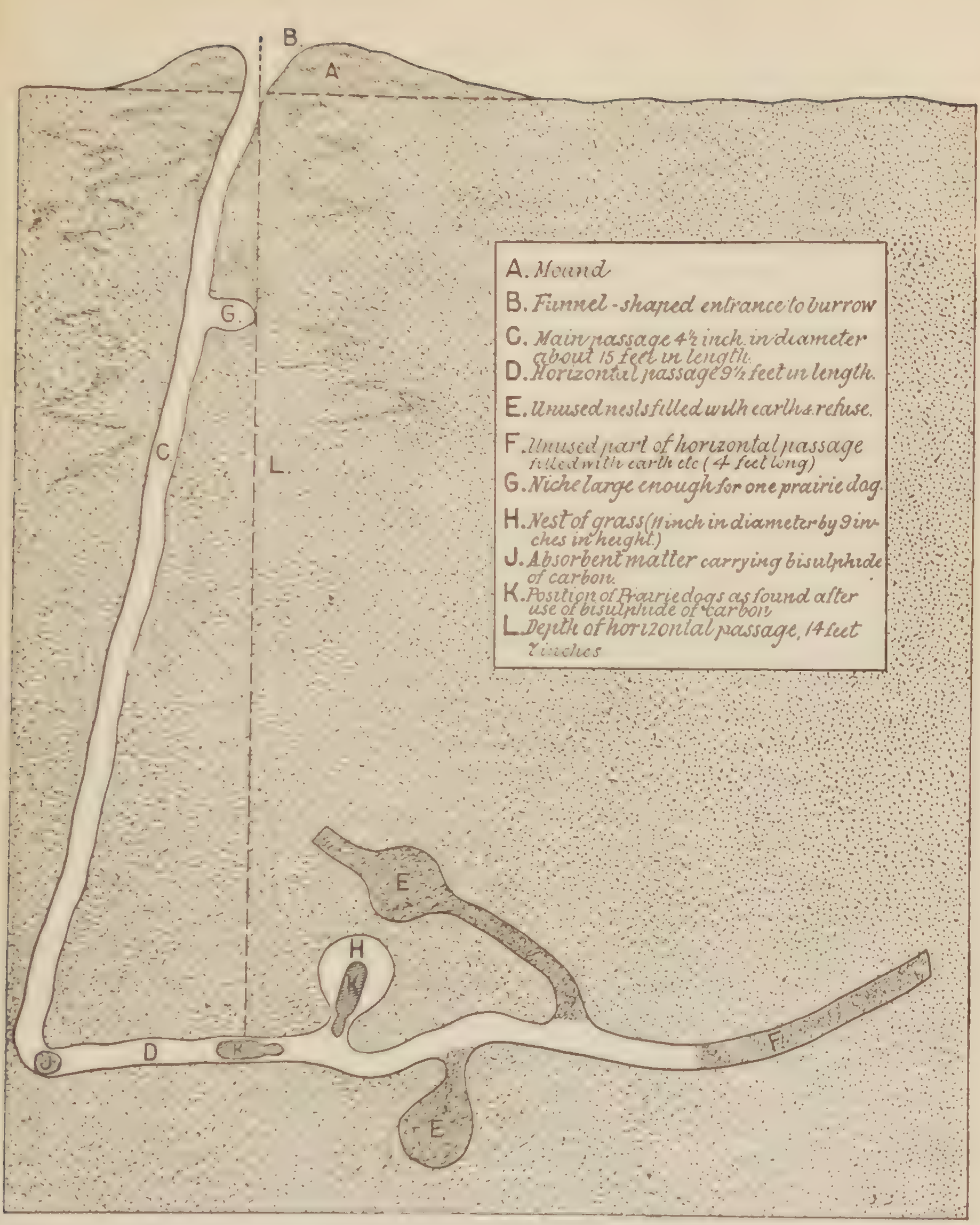

B.
A.
G.
C.
L.
E
H
K
J
D
K
F
E
A. Mound
B. Funnel-shaped entrance to burrow
C. Main passage 4½ inch in diameter about 15 feet in length.
D. Horizontal passage 9½ feet in length.
E. Unused nests filled with earth & refuse.
F. Unused part of horizontal passage filled with earth etc (4 feet long)
G. Niche large enough for one prairie dog.
H. Nest of grass (11 inch in diameter by 9 inches in height.)
J. Absorbent matter carrying bisulphide of carbon.
K. Position of Prairie dogs as found after use of bisulphide of carbon
L. Depth of horizontal passage, 14 feet 7 inches

PLATE XXIX.—PRAIRIE-DOG BURROW, DUG OUT BY DR. W. H. OSGOOD

From *The Prairie Dog of the Great Plains*, by C. Hart Merriam

His Home Tree

Occasionally one finds a mound or high lookout which is picturesquely embellished with a carefully preserved bush as shade tree or home marker. Concerning these, Lantz says:

"Sometimes a weed is permitted to grow to maturity on the cone-like mound at the mouth of a burrow. Only three species of weeds have been seen so growing by the writer—the horse nettle (*Solanum rostratum*), the Mexican poppy (*Argemone*), and a Euphorbia (*Euphorbia marginata*). These afford shade to the animals, but do not obstruct the view. All other weeds, and even cultivated crops, are cut down to prevent the unseen approach of an enemy. When the cultivated crop is some rapid-growing or dense one which they cannot clear away, they abandon the land rather than stay to be devoured."[14]

His Inter-burrow Subway

Dr. W. H. Osgood was one of the very few persons who had the time, combined with opportunity and industry, to dig out and fully investigate the home of the Wistonwish. The result of his energy is given as follows:

"In this case, the burrow went down nearly vertically to a depth of 14½ feet below the surface, when it turned abruptly and became horizontal, as shown in the diagram. (See Plate XXIX, p. 285.) The horizontal part was 13½ feet in length. One-third of the horizontal part, the terminal 4 feet, (F) and two old nests and passageways (E) were plugged with black earth brought in from the surface layer, which was very different from the light-coloured clayey earth in which the greater part of the burrow lay.

"Four or five feet below the entrance was a diverticulum, or short side passage (G), probably used as a place in which to turn around when the animals come back to take a look at the intruder before finally disappearing in the bottoms of their burrows. It is used also, apparently, as a resting place where they bark and scold after retreating from the mouths of the burrows. . . . They are often heard barking after they have gone in.

"The burrow was opened the day after bisulphide of carbon had been used for destroying the animals, and the material carrying the bisulphide was found at the bottom of the vertical part, just where the horizontal part turns off. Two dead animals were found, one in the horizontal part, the other in the nest, as indicated by the letter K in the diagram."[15]

Enos A. Mills, investigating a dog-town, had the luck to see a cross section made by a steam shovel. "The Dogs barked and protested," he says, "but railroads have the right of way. The holes descended straight and almost vertically into the earth to the depth of from 10 to 14 feet. From the bottom, a tunnel extended horizontally for from 10 to 40 feet. There was a pocket or side passage in the vertical hole less than 2 feet below the top; and a number of pockets or niches along the tunnel, with buried excrement in the farther end of the tunnel. The side niches were used for sleeping places and side tracks. There was a network of connecting tubes between the vertical holes and communicating tunnels. . . .

---

[14] Coyotes in Their Economic Relation, Biol. Surv. Bull. 20, 1905, p. 13.

[15] Merriam, Prairie-dog, Great Plains, pp. 260–62.

"I found the underground works of the Dogs similar in other railroad cuts. None of the holes reached water; in fact, they were extra dry in the bottom."[16]

The Riddle

Thus, our investigations have revealed a wonderful underworld—the home-town of Wistonwish. Besides some peculiar features, this sub-soil labyrinth has nearly everything that any animal burrow has, and has it in perfection. The carefully digged lookout and plunge-hole are most obvious from above; with the burrow, chamber, dry-earth closets, emergency cell, and storehouse deep under ground, beyond the damage of man or beast, frost or storm. Even flood is offset with a place of refuge, as we shall see. We are reminded of the consummate and complex engineering of Beaver and of Pocket-gopher.

In seeking to understand the how and why of the subway, we are confronted with a riddle. Most burrowing animals have three types of opening into the ground the easy sloping tunnel, the prospect hole made when digging for food, and the plunge-hole. The Prairie-dog is peculiar in omitting the first two; all his holes are of the last kind; all are plunge-holes.

Which raises the question: How does he get the earth up that perpendicular shoot? He cannot scratch it out behind him, as do other rodents; he cannot carry it out in his arms or mouth; he cannot boost it out on his head; he has never yet been seen carrying a basket. And yet he successfully digs a shaft down nearly straight for 10 or 12 feet. Will someone tell us how?

Preparing for Weather

Sometimes, says Merriam, the repairs of the rim wall "are made before rains, and some observers regard the animals as exceptionally clever weather prophets."[17]

---

[16] Watched, pp. 219–20.

[17] Prairie-dog, Great Plains, p. 260.

Major H. W. Merrill says of the pet Prairie-dog that he kept at Fort Washita, Indian Territory, in the summer of 1853: "Whenever Jack was seen busily engaged hauling in the earth with his feet, around his hole, and packing it hard with his nose, no matter if the day was as clear as a crystal, then we had unerring notice of a coming storm. . . . He is the barometer of the Plains."[18]

Julia S. Gillis, writing of those she kept in semi-captivity near Cheyenne, says: "They are indefatigable in their efforts to keep the holes open, and have been a source of annoyance by this persistence. One opening, which they made near the hitching post, was considered dangerous for the horses' feet. Numerous efforts have been made to close it up, but without success. Water was turned in, and a steady stream maintained all day. In the evening, a load of stones, gravel and sand was put in, and thoroughly packed by the water. Next morning, a heap surrounded the hole in which the victorious Dogs were still working like Beavers at the last few stones.

"Next we took heavy wires, bent in various shapes and coils, which were fitted in first, and then sand and gravel pounded in; but with the same result. The following morning revealed the Dogs at the mouth of the already cleared-out hole, practising calisthenics with the wires. A third attempt was made with jagged tin cans and blocks of wood, but all to no purpose. They still rule supreme, and so far have proved the futility of intelligence against instinct.

"Even in the winter, they work with the same industry to clear away the snow from their doors, and very few days were sufficiently stormy to keep them in; thus proving the fallacy of the belief (at least in their tamed condition) that they are hibernating animals."[19]

In Case of Flood

Never shall I forget that Christmas Day, 1893, when, with H. M. Foster, manager of the L-F Ranch near Clayton, N. M., we tried to drown out a Prairie-dog town by turning into it an irrigation ditch. After running a 6 x 2 inch stream into one of the holes for a couple of hours, we did indeed fill the town's underworld with water; but nary a Prairie-dog came out. A few days later, the flood was assuaged and gone; and the Prairie-dogs came out as before, with no apparent reduction in numbers. Several old-timers, looking on, told us it would be so. Indeed, they had had less luck than we, for during similar trials, they had not even been able to fill the holes.

---

[18] Hist. Prairie-dog, p. 370.

[19] Pet Prairie-dogs, p. 196.

Harry A. Ringle writes that all his attempts to drown out the Prairie-dog were failures. In one case, he poured about 75 barrels of water into the same den, and the last barrel went as easily out of sight as the first.[20]

This immunity from flood damage will be understood by reference to the observations of B. E. Foster, of the Biological Survey, Phœnix, Ariz. He says:

"The diagrams herewith submitted showing construction of laterals used by Prairie-dogs, are taken from burrow excavated near Prescott, Ariz., by Mr. R. R. Beck and the writer on Oct. 5, 1923. (Plate XXIXa, p. 285.)

"This burrow, along with many others, showed to have been under at least three feet of water only a short time before; yet judging from the number of live Dogs seen at this time, there had evidently been very few drowned. This was verified by the owner of the ranch, who further stated that he had seen this area under water for several hours at two different times during the season, and that he could never tell that any Dogs had disappeared.

"As there were 7 of these laterals in this burrow system, and 5 of the number came to within 8 inches of the surface, it is quite evident that the Dog can remain in either of them in comparative safety for several hours, as the inrush of water would cause an air pocket to form in the top of the lateral which would last until the air could escape through the earth. As the surface of the ground gradually became moist, the air would have less tendency to escape, and it is the opinion of the writer that this supply of air would be sufficient to last the Prairie-dog for several hours."[21]

The Den as a Home

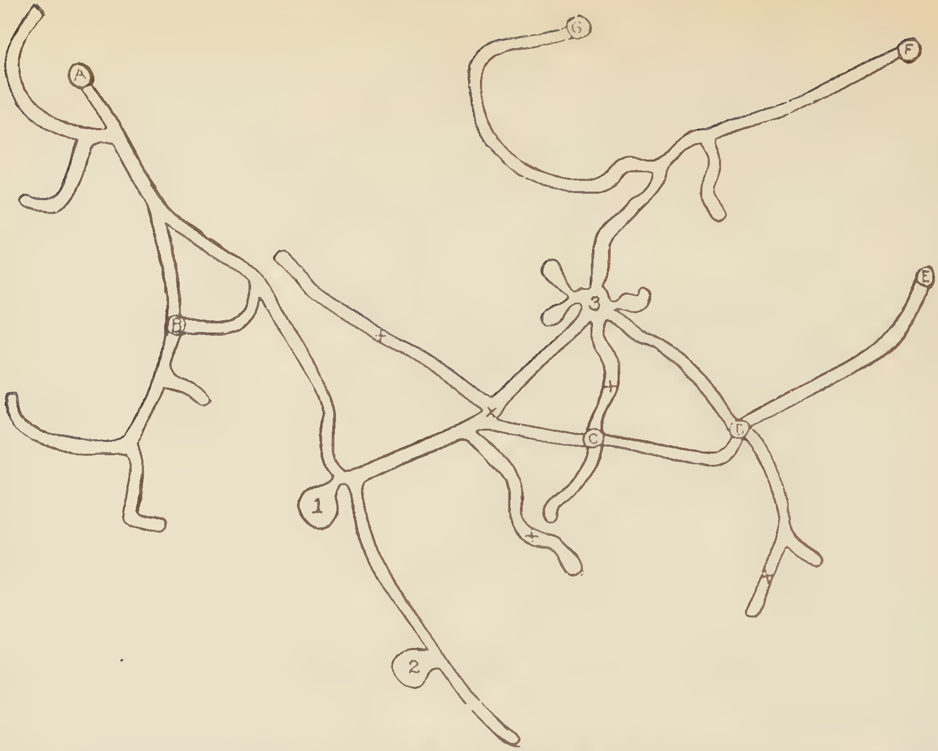
Far down, in the only safety that can be found on the Plains, is the home den of Wistonwish. He is a marvellously abundant animal; but so seldom studied as a little brother, that we know almost nothing of his home ways or views of life. His marriage customs have not been observed; but it is unlikely that they are ideal. He comes of a stock that has lax views on nearly all important subjects. He lives in a town, and has much idle time. He is a chatterbox. Enough said.

W. L. Burnett, writing of the creature in Colorado, says: "Contrary to general opinion, Prairie-dogs breed but once a year. The young vary from 3 to 4, and are born from the latter part of April to the first of June.

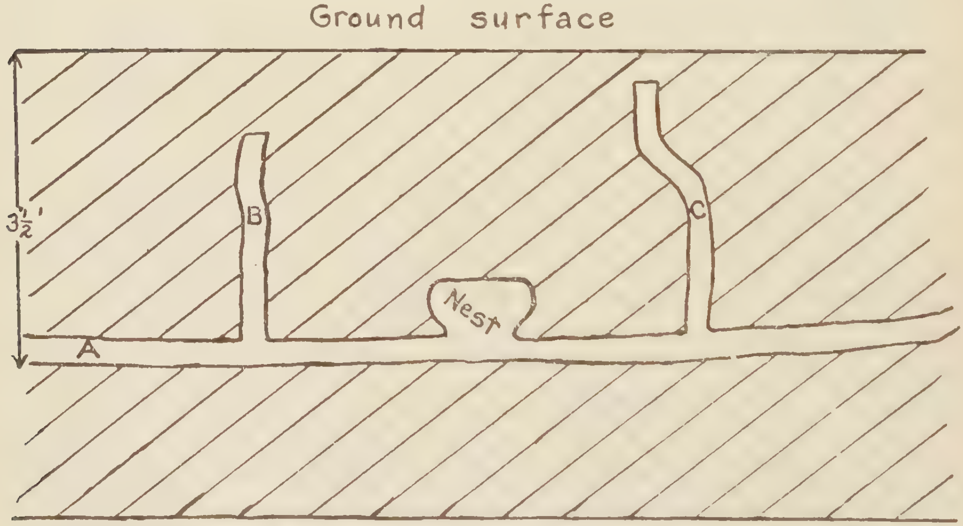
---

[20] Hunter-Trader-Trapper, June, 1924, p. 20.

[21] Journ. Mamm., Nov., 1924, pp. 266–68.



Scale, 1 inch = 4 + feet. Average depth, 3½ feet; diameter, 5 inches. A B C D E F G indicate entrance to burrow. × indicates location of laterals going straight up from burrow. 1, 2, 3 indicate nests



A—Main runway of burrow. B—Lateral going straight up from burrow to within 18 inches of surface. C—Lateral reaching to within 6 inches of surface

PLATE XXIXA. PRAIRIE-DOG BURROWS, BY B. E. FOSTER

(From Journal of Mammalogy, Nov., 1924, p. 267)

Latitude and altitude are important factors in the cause of this variation in date in which the young are brought forth."[22]

His Way of Life

This creature is strictly diurnal, loving the hours of pleasant sunlight, rising with the sun, and descending in the sunset glow. In excessively hot or extremely cold weather, he is rarely seen.

Some writers claim that Yek-Yek hibernates in all the northern part of his range. I know that he is active all winter in northern New Mexico; and near Livingston, Mont., I saw many of the species running over the snow on Jan. 28, 1914.

Commenting on this, J. Stokley Ligon says, "The Whitetails hibernate during the winter, the Blacktails do not."[23]

In captivity, we may get a good synoptic view of the Yek-Yek life.

On Nov. 4, 1925, I went to the National Zoo at Washington, D. C., to see the Prairie-dogs. There was an unusually fine lot in the pen and so tame that they were easy of observation.

The old ones were busy carrying in hay, either for bedding or for food, or both. None of the young of the year seemed impelled by this provident instinct.

In eating, they sat up on their hindquarters, and held the food in one paw. At first, all seemed right-handed, but later I saw one eating left-handed.

When meeting a friend, they saluted by "kissing"; that is, with both snouts near the ground, each rubbed his lips first on one side, then on the other of his friend's muzzle.

The old ones were at work raising the rims of the craters; not by digging out from below, but by gathering the clay from the surface for 5 or 6 feet around, and building it up into a narrow wall a foot high, evidently preparing for a time of floods or deep snow.

Many of them had a trick of nibbling each other's tail around the root; one or two had lost their tails in part. Sometimes an incorrigible nibbler pursued his victim round and round until the persecuted one turned to fight. It seems to be a morbid a cage habit. I never saw anything of this in a state of nature.

When alarmed, they made first for the mound at their hole. On this, they sat up keenly alert. The jerking of the tail once or twice, was used as a mere warning—a signal that all the others saw and heeded.

---

[22] Prairie-dog in Colo., p. 10.

[23] Personal letter.

Associated with this, was the ordinary "*quek*" or bark for which they are named. This was definitely a note of alarm.

When they were scattered far from their holes, and one gave a sharp "*squit-tuck*," all ran for cover.

The note "*skr-skirr*" means fighting or menace. It was frequently heard when they were disputing among themselves.

They had in addition a number of squeaks and chatters that were used in conversation or in squabbling.

But the most singular vocal exercise was the *song*. This was uttered by the old ones, both sexes, I think, at any time, without obvious motive or visible cause. Suddenly one would rear up, and with snout to the zenith, utter a soft "*Wee-oo*," then drop down again on to all four feet. The action was momentary, and defied all attempts to photograph it. But I made the accompanying sketch which I believe is correct for all those I saw that day. It exactly suggested the attitude of a sun-worshipper; and the song might be called his song of praise or joy. (See cut on p. 298.)

It has been said that the Prairie-dog, so semi-tame when wild, is not known to respond to kind treatment in captivity. But Julia S. Gillis, writing of the village of over 20 Prairie-dogs in her front yard at Cheyenne, says:

"Having habitually fed them, they regard me as a constant friend, and my approach is the signal for the rallying of their forces around my feet. They climb in my lap, up on my shoulder, impudently nibble my buttons or fingers, while their inquisitive little noses are sniffing vigorously for the cake or cracker which they know I have somewhere concealed for them. . . .

"One of them has been named Billy, and will always come when called, even from the depths of his hole."[24]

A Venerable Joke

For the joy of those who believed in an animal millennium, it was told that the Prairie Bow-wow, the Prairie owl, and the Prairie rattlesnake lived together as a happy family in the den so lovingly prepared for the others by the very capable and beneficent little rodent animal himself. It was such a pleasant, logical, and acceptable fable that many good books and readers fell into the Munchausen snare. The truth-seekers have had a hard time in combat with this sturdy lie.

---

[24] Pet Prairie-dogs, p. 196.

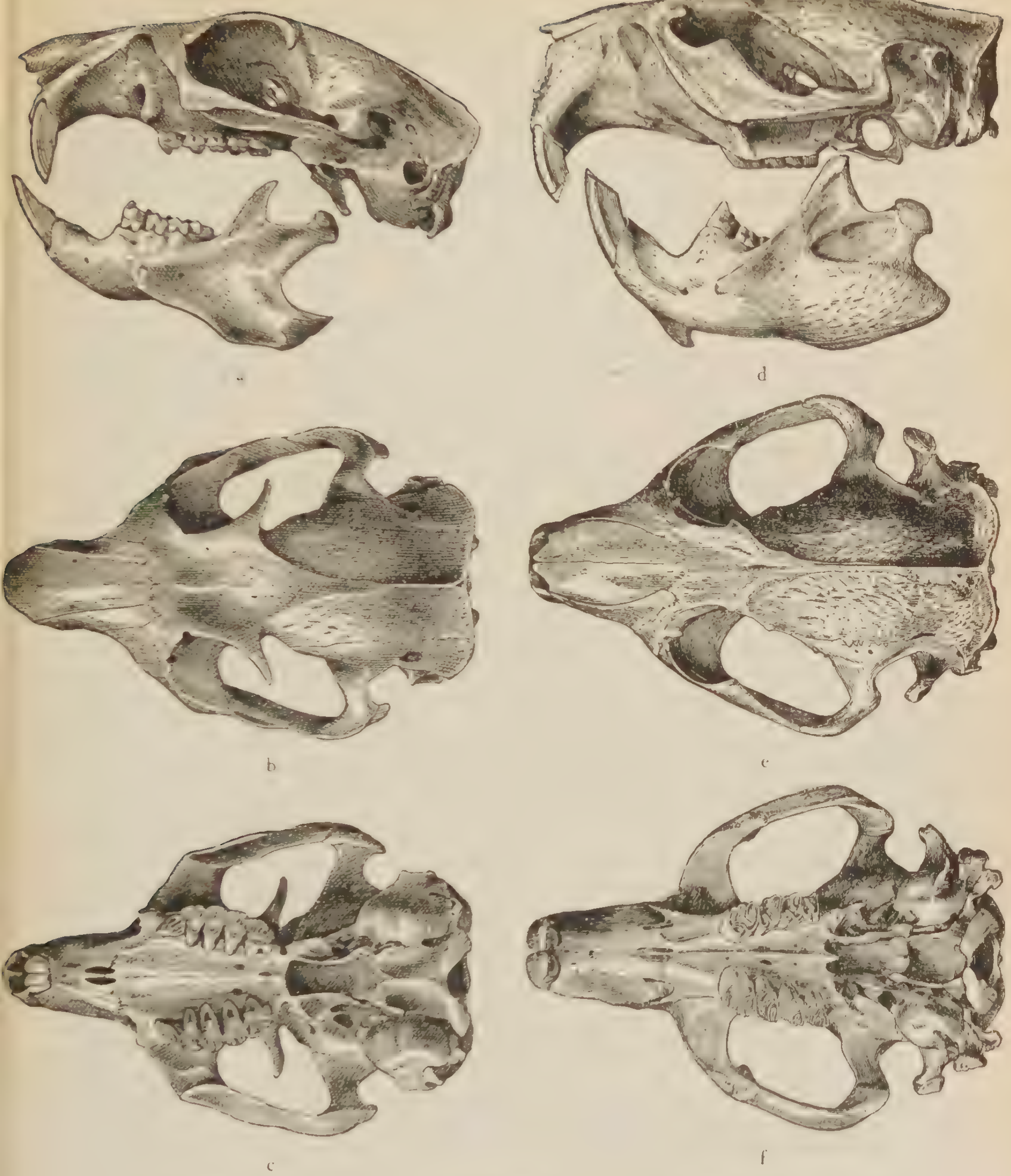


PLATE XXX. SKULLS (a, b, c) PRAIRIE-DOG (*C. l. arizonensis*) LIFE SIZE: (d, e, f) BEAVER (*C. c. frondator*) ½ LIFE SIZE

These cuts are from Mearns's *Mammals of the Mexican Boundary*, supplied by the U. S. National Museum

As early as 1874, Dr. E. Coues, in his "Birds of the Northwest" (p. 324), took opportunity to expose this fable with characteristic pungency of wit. He says:

"No little pure bosh is in type respecting the harmonious and confidential relations imagined to subsist between the trio, which, like the 'happy family' of Barnum, lead Utopian existences. According to the dense bathos of such nursery tales, in this underground Elysium, the snakes give their rattles to the puppies to play with, the old Dogs cuddle the owlets, and farm out their own litters to the grave and careful birds; when an owl and a Dog come home, paw-in-wing, they are often mistaken by their respective progeny, the little Dogs nosing the owls in search of the maternal font, and the old Dogs left to wonder why the baby owls will not nurse."

Let us deal fairly and firmly with the myth.

Every one of us old-timers recalls the fact that a Prairie-dog town was frequented by burrowing owls and by rattlesnakes; that the burrow of Yek-Yek was the home of the other two. Of this there can be no question. But wait for the fuller evidence of those who knew them well.

Cope, in his "Monograph on the Reptiles of North America," says, in quotation of Dr. H. H. Brons:

"This rattlesnake is a universal companion of the Prairie Marmot, *Cynomys ludovicianus*. I have observed them together from near the Canadian border in Montana to the southern extremity of the Staked Plains in central western Texas. Not only do the Marmots provide them food, but their burrows furnish them a safe refuge. . . .

"Prairie-dogs (*Cynomys ludovicianus*) seem to have a most intense dread of rattlesnakes (*Crotalus confluentus*). This little animal dreads not only its venomous bite, but more the loss of its young, which serve as food for these snakes that enter their burrows, take possession, and drive them from their homes. Where does one find a Prairie-dog town but that it is teeming with snakes and the strange little owl (*Speotyto cunicularia*) that 'ducks' to passers in ludicrous solemnity? These do not constitute a happy family. The owls, though they generally occupy an abandoned hole or burrow, destroy the young Dogs.

"Nor do the eggs and nestlings of the owls fare with any better treatment from the snakes; between these exists much enmity. One afternoon, while passing through one of these dog-towns in Wallace Co., Kansas, we heard a most unusual noise and stir [in the town], as though they were holding a bellicose council. They were collected around a hill, into which they were scraping dirt vigorously. On examining the burrow, it was found to

PLATE XXXI.—THE WISE WOODCHUCK

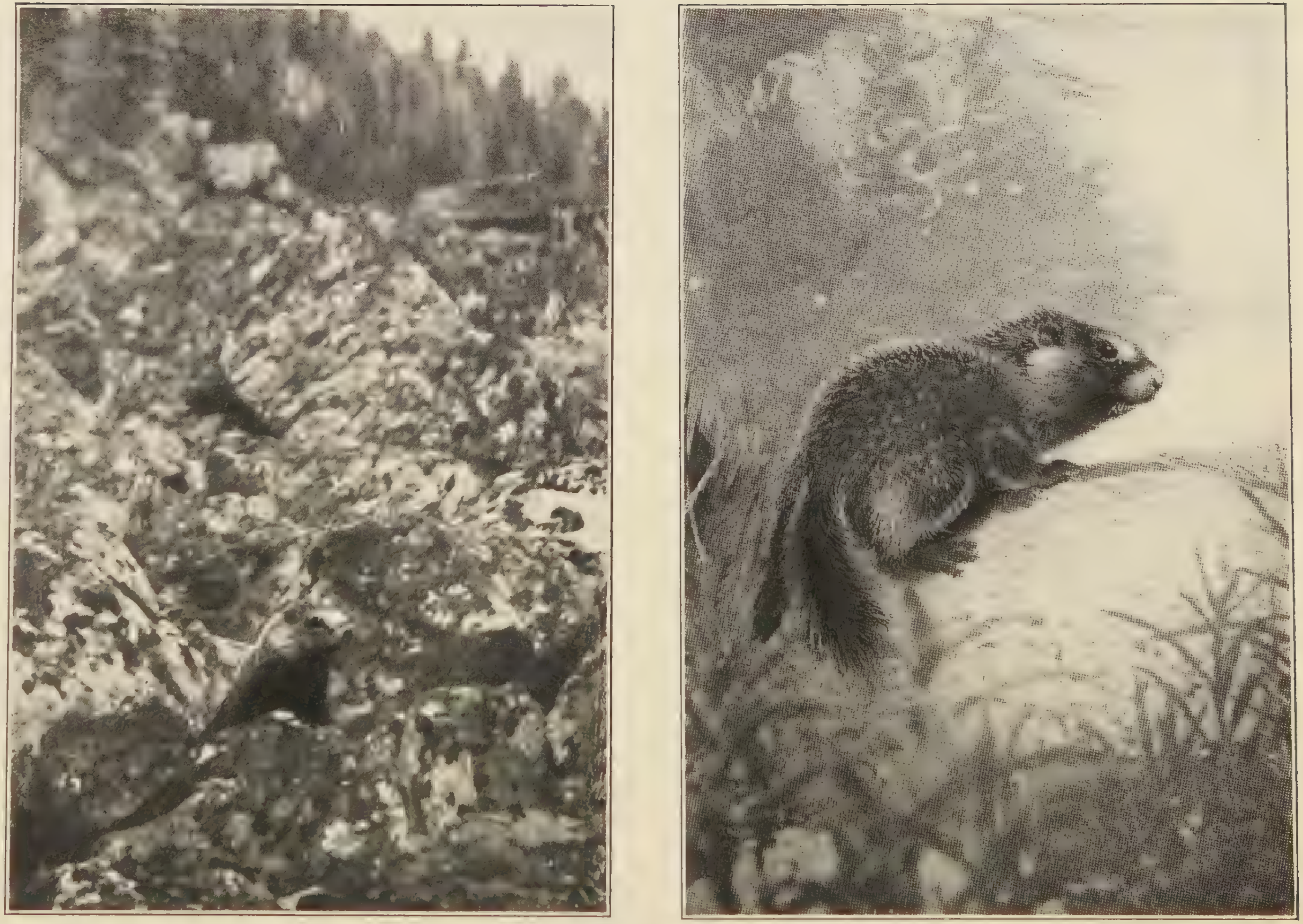


PLATE XXXVI.—ROCKCHUCKS AT HOME

contain a large rattlesnake that the Dogs were trying to entomb." Similar incidents were noted several times by the party.[25]

Major Merrill says, in his account of a pet Prairie-dog:[26] "We had also the dry skin of a large snake, skinned with the rattles left on it. This gave us a good opportunity to test, as we did, the Dog in his love or fear of the snake. We found by shaking the skin and rattles, that he would no sooner catch the sound, than away he would go for his hole, and become so alarmed that, contrary to his custom, he would sometimes remain a whole day out of sight. And when he did come out, it was with evident great fear.

"This experiment was also tried when he could see no motion, and with the same results."

In *Hunter-Trader-Trapper* for June, 1924, pp. 19-20, Harry A. Ringle writes at length on Prairie-dogs and rattlers in Texas. He gives many observations to show that a Prairie-dog will not enter a burrow in which there is a rattler. He maintains, furthermore, that if the Prairie-dogs refuse to enter a certain hole, it is not safe to put your hand down in that hole.

Other Enemies

Major H. W. Merrill, in his admirable account of the Prairie-dog, first drives a few nails into the coffin-lid of the Happy-Family myth, then speaks of other enemies. In Jan., 1855, when near Fort Belknap, Texas, he says: "I had an opportunity of watching a Panther trying to get his dinner of Prairie-dogs. He would wait quietly till one appeared, and then make a spring. But, time after time, the Dogs were too quick for him, sank to their safe holes, just before the Panther touched the spot where they had sat. A few trials of this sort so alarmed the whole town, that none of the little fellows would venture out."[27]

In strong contrast to the Panther's open and futile attack, is the clever stratagem so often employed by the Coyote, and fully set forth in the Life of that animal (Vol. I, p. 378).

Mrs. J. M. Grant, describing her pet Prairie-dogs, tells of the death of one in a peculiar way. During warm weather, they were easily made comfortable out of doors. "But," she says, "just before I decided to take them into the house, one died—stung by a jellow-jacket, I believe, as this insect was found dead with the body about 3 inches underground."[28]

---

[25] Ann. Rep. Smiths. Inst., 1900, pp. 1173-74.

[26] Hist. Prairie-dog, p. 370.

[27] Hist. Prairie-dog, pp. 369-70.

[28] Personal letter, Chicago, April 11, 1902.

In addition to these, the Wolf, the Coyote, the Fox, the Badger, the Blackfooted Ferret, and the large Weasels, as well as eagles, hawks, and bull snakes, are of one mind in considering the Prairie-dog fair game and delectable diet.

Who Buries His Dead?

In close relationship to the burial of their enemies is the widely attested impulse of Wistonwish to bury his own dead.

W. L. Burnett, of Colorado, says: "I am of the opinion that they do occasionally bury their dead. I have often noticed, in going over a Prairie-dog town a few days after poison had been put out, if there were any Dogs left to tell the tale, that a number of holes had been neatly filled.

"I can recall to mind, a few years ago, shooting a Cottontail Rabbit in a Prairie-dog town. When shot, the Rabbit jumped several feet in the air, fell on a Prairie-dog hole, and kicked itself down out of sight. The hole was marked, and returned to after a few hours, only to find that it had been filled, presumably by Prairie-dogs."[29]

Deep and strong is this instinct of Mother Earth's own brood to confide to her whatever sad, unpleasant secret they gladly would forget. Maybe this is the thought that is motive in the following incident offered by Mills.

In the dog-town where he made many observations, he saw one old Prairie-dog attacked by a mob. Though they handled him roughly, "the wise old Dog refused to go into a hole, but was literally jammed in, with earth clawed in after him until the hole was filled, then another barbaric, triumphal war dance upon the buried one. . . .

"What was the offence of the old Dog which had been attacked by his fellows? Was it crime or misdemeanour? Had he been misunderstood, or was it a case of circumstantial evidence?

"In other dog-towns, I have seen the populace putting one of their number to death; and in this town, about two years later, I saw two Dogs entombed by the same wild mob. In this case, even the sentinels forgot the Coyote and joined the mob. Were the executed ones murderers, robbers, or had they denied some ancient and unworthy superstition, and, like reformers, paid the penalty of being in advance of popular opinion?"[30]

In the section on Colour Freaks, is narrated the lynching of an undesirable by a dog-mob; but it is not stated that they buried the corpse.

---

[29] Prairie-dog in Colo., p. 10.

[30] Watched, p. 225.

Strange Habit Overdone

In my sketch of the Prairie-dogs at Washington Zoo, I tell of the pose of Yek-Yek when he would prove himself a very bird of song. Apparently in line with this is the following sent me by Mrs. J. M. Grant.

Describing her pet Prairie-dog from Nebraska, she says: "When we speak to him, he barks and throws himself straight on to his back. Then he gets up hastily and does it again, sometimes 5 or 6 times. The hair on his head has become rough from the bumps received in the process."

Good-bye

Good-bye, little Yek-Yek, Earth-spirit of the Shining Plains.

I used to think you, as I rode, a thing as much an enduring part of all things as the towering buttes and shimmering sands.

I neither loved you nor disliked you.

You were as the cactus was—a little part of the big thing that I loved and lived.

I never did suppose the day would come when you would be listed as a blackleg, and all the power of science and of "Unkasam" invoked to wipe you out.

Yet such a thing has come.

I travel now again in Oklahoma where once were plains and dog-towns spread.

There now I see alfalfa fields; and in the spring when the fresh black soil is bare, I see yellow spots at every twenty yards, and know these mark the graves and bygone homes of Prairie-dogs—that the Dogs are gone.

The Juggernaut of "Other-thought" is sweeping, grinding, all the Plains.

I suppose it must be so.

I never loved you when I had you.

And even now, I know my love is only this: that you figured in my golden age—my youth, so long gone by.

You have crossed the Big Divide, or soon will cross.

Good-bye for a while—but only a little while.

I am coming too.

References

1876—History of the Prairie-dog, by Major H. W. Merrill, *Forest & Stream*, July 13, pp. 369–70.

1876—Pet Prairie-dogs, by Julia S. Gillis, of Cheyenne Depot, Wyo., dated Aug. 14, appearing originally in *Rod & Gun;* reprinted in *Forest & Stream*, Nov. 2, p. 196.

1901—The Prairie-dog of the Great Plains, by Dr. C. Hart Merriam, Yearbook Dept. Agric., Wash., D. C., pp. 257–70; 1 map, 4 pl.

1915—The Prairie-dog Situation in Colorado, by W. L. Burnett, office of State Entomologist, Ft. Collins, Colo., Circular 17, Oct.; 15 pp. 2 ills.

1916—A Systematic Account of the Prairie-dogs, by N. Hollister, N. A. F. 40, Wash., D. C.; 37 pp., 7 pl.

1922—Watched by Wild Animals, by Enos A. Mills.

LIFE LXXVIII—THE WOODCHUCK

PAGE
Names 300
Description: Size, Weight, Colour, Colour Freaks, The Ear, Freak Teeth 301
Races 303
Range 303
Haunts and Home Range 303
Numbers 304
Burrow—Home and Refuge 305
His Food and Drink 308
As Meat-eater 309
Can He Climb? 309
Can He Swim? 312
Fur and Pelt 312
As Food for Man 313
As a Vocalist 313
The Mating of the Monk . . . 316
The Young . . . 316
Groundhog Golf . . . 319
Monax—His Calendar . . . 319
Groundhog Day . . . 321
Springtime . . . 321
Enemies 323
Sanitation 325
Tame and Kind 326
The Wail of the Worsted 327
The New Sport—Chuck-hunting . . . 330
His Way of Life 331
Songidazzy, Little Strong-soul . . 333
Long Ago and Now 335

References 336

The Woodchuck, Chuck, Wood-shock, Groundhog, Ground-pig, Whistle-pig, Whistler, Thickwood Badger, Canada Marmot, Monax, Moonack, Weenusk, The Red Monk

Marmota monax (Linnæus)

Marmota—the Italian name is *Marmotta*—from L. *mur*, stem of *Mus*, a Mouse or Rat, and *mont*, stem of *mons*, a mountain; hence, a Mountain Rat. *Monax*, the Indian name)

[*Mus*] *monax* Linnæus, 1758, Syst. Nat., X ed., I, p. 60.
[*Marmota*] *monax* Trouessart, 1904, Catal. Mamm. viv. foss. suppl. p. 344.

Type Locality—Maryland

French Canadian, *le Siffleur; la Marmotte du Canada.*
Cree, *Wee-nusk';* also *Weé-nee Suk'-ah-tip* (on Athabaska).
Ojibway, Sauteaux, and Muskego, *Au-kuk'-wah-djees.*
Chipewyan, *Thel-lee-cho* (big Ground-squirrel).
Yankton Sioux, *Hoh-cush-a.*
Santee Sioux, *Hang-kasha.*

The name "Thickwood Badger" was given in the Northwest to distinguish the animal from the true or Prairie Badger. "Siffleur" or "Whistler" is from its note; and it is, of course, a true "Marmot."

Richardson derives "Wood-shock" from the Cree "Otchoek," sometimes written "Wejack," but applies the name to the Fisher. This, however, may be a mere coincidence, for it was in the mid-Atlantic States that these names became current; and we should remember that in Natick, Woodchuck is *Ockqutchaun*, as also is Hog. In Choctaw, the Hog is *Shukha*, which may easily become *Chuck*.

In 1743, Mark Catesby, in his "Natural History of Carolina, etc.,"[1] described the Common Woodchuck under the popular name *Monax*. In 1747, George Edwards, in his "Natural History of Uncommon Birds" (if you please) again described the creature as the *Monax* or *Marmotte* of America.[2] Neither gave any Latin names.

In 1758, Linnæus gave to the species its first scientific name, *Mus monax*. It has been the custom to explain this specific name as Latin for

---

[1] Vol. II, App. p. xxviii.

[2] As above, p. 107.

Monk; but the Latin for *Monk* is *Monachus*. T. S. Palmer gives "Latin, *Monax*, solitary"; but I could not find it in any Latin dictionary consulted.

I do, however, find in Brinton and Anthony's Lenape Dictionary, the Indian word *Monachgen*, a Ground-hog, from *monham*, to dig. Edward A. Preble reports that in southern Virginia the Woodchuck is still known locally as *Moonack*.[3] Catesby dealt only in popular and native names. The evidence, then, is overwhelming that *Monax* was an Indian name of the Woodchuck, and meant "the digger."

The genus *Marmota* (Frisch, 1775) comprises large rodents that have the following characters: form, stout; tail, short and bushy; ears, very short; thumb on front paws, a mere knob, with a nail; the other 4 fingers with claws; 5 well-developed toes on hind feet; very small cheek-pouches. Teeth:

$$\text{Inc. } \frac{1-1}{1-1}\text{; prem. } \frac{2-2}{1-1}\text{; mol. } \frac{3-3}{3-3} = 22$$

In addition to the generic characters, the Woodchuck has the following:

Size. Total length, about 24 in. (610 mm.); tail, 5½ in. (140 mm.); hind foot, 3 in. (76 mm.).

Weight of adult, 9 to 10 lbs. I have seen an adult female that weighed only 3 lbs.

Bachman records an adult male at 9 lbs. 11 oz.[4]

Leoren D. Ingalls, of Vermont, writes: "The biggest Woodchuck I ever shot . . . was killed in September, and weighed 11¼ lbs."[5]

P. K. Rossiter, of Ithaca, N. Y., writes that he has killed a Woodchuck that weighed 12¾ lbs.[6]

A writer in *Forest & Stream*[7] gives the average weight of 158 as 10 lbs.; the heaviest 13½ lbs.

Colour. In general appearance, this is a grizzly gray animal, with dark head, chestnut legs, and black feet. The white teeth are conspicuous when one is near. In most big rodents they are yellow.

A male taken in Connecticut, May 1, 1925, is as follows:

The coat above consists of woolly underfur, whose deeper half is nearly black, and whose outer half is warm buffy that gives the general colour to the mantle. The long guard hairs through it are black except the tips, which, for a quarter or less, are dull white. This gives the grizzling.

---

[3] Revision, p. 8.

[4] Q. N. A., I, p. 18.

[5] Forest & Stream, Dec., 1923, p. 700.

[6] Recreation, Feb., 1898, p. 151.

[7] Dec. 1, 1900, p. 424.

The head is umber brown above, with a dull whitish spot over each eye; below and on cheeks, dull brownish white.

The chest and arms are strongly tinged with reddish brown or rusty. On the hind legs, the same tingeing is moderately seen. The paws and feet are black. The belly is like the back, but sparsely haired and dull. The tail is brownish black, lined with black, but without white tipping. The ears are dull grayish brown inside and out. The claws are blackish brown, pale for the final third.

Colour Freaks. Albino Woodchucks are common. In the *N. Y. Zoological Society Bulletin* for Nov., 1921, pp. 127, 131, are mention and picture of a white Woodchuck in the N. Y. Zoological Park. There is also a single albino in the Fairbanks Museum at St. Johnsbury, Vt.

Very dark, nearly black, specimens are common. I have seen two from near Toronto, Ont., two from St. Johnsbury, Vt., one from St. Louis, Mo.

John Burroughs writes me: "Two afternoons ago, aided by some friends we dug out a Chuck here, which was very dark, but not quite black."[8]

Howell writes: "A melanistic phase is rather common in New York and New England. The darkest specimen seen (from Lake George, N. Y.) is dark blackish brown all over, except the head and face, which are mixed mummy brown and benzo brown. Other specimens from New York State are dark chestnut brown. Vernon Bailey states that he has seen a very few black individuals in Minnesota."[9]

Raymond S. Spears says: "Roughly, boys divide the Woodchucks into three classes, meadow, pasture, and black. The last are almost invariably found in second growth or in the woods. They are a smaller, warier animal apparently. Of a hundred Woodchucks killed, only one or two would be black.[10]

The Ear. The following by Godman is important, if sustained by fuller investigations: "The ear is provided with a muscular apparatus, by which the upper portion is brought down, and the sides of the lower portion are so accurately pressed against each other, as effectually to exclude the smallest particles of dirt or dust."[11]

Freak Teeth. On Plate XXXIV (p. 322) are shown a number of overdeveloped teeth. The inset is from *Forest & Stream* Jan. 7, 1899. The other three are from George Wagner's article in *Journal of Mammalogy*, Feb., 1923, p. 21.

---

[8] Personal letter, Roxbury, N. Y., Oct. 11, 1920.

[9] Revision, p. 17.

[10] Woodchuck Ways, p. 176.

[11] Amer. Nat. Hist., 1842, I, p. 330.

RACES

The following races are recognized in Howell's *Revision:*

monax Linnæus, the typical form, a medium sized and buffy animal. T. l., Maryland.

rufescens Howell, like *monax*, but redder, paler than *ignava*. T. l., Elk River, Minn.

preblorum Howell, medium sized and pale, redder than *monax*, but the red not so dark as in *canadensis* or *rufescens*. T. l., Wilmington, Mass.

ignava Bangs, equalling *rufescens* in size and colour, but paler; skull short and broad. T. l., Black Bay, Labrador.

canadensis Erxleben, of small size; very red; small skull. T. l., Quebec, Can.

petrensis Howell, much like *canadensis*, but with longer and larger skull. T. l., Revelstoke, B. C.

ochracea Swarth, much like *petrensis*, but paler below, and above peppered with ochraceous. T. l., head of Forty Mile Creek, Alaska.

RANGE

Map X (p. 341) shows the Woodchuck to be a creature of the Canadian and Alleghanian Faunas, with a slight overflow into the Hudsonian on the north, and into the Carolinian on the south. In the Western or mountain region, the species is largely displaced by its rock-inhabiting cousin, the "Yellow-belly."

The long leg thrust southwestward down the highland from Virginia is evidence of a successful creature feeling its way in congenial surroundings to new territorial possibilities. Concerning its extension here, Ernest G. Holt says: "The animal is so rare in central Alabama, that when a straggler is seen, the natives are at a loss to know what it can be."[12]

In Manitoba, it is found throughout the Province except on the open plains, and in wet regions.

HAUNTS AND HOME RANGE

This is a forest animal, but prefers the edges of sunny openings rather than the gloomy depths; and at all times is found in dry, high situations.

---

[12] Journ. Mamm., Feb., 1924, p. 67.

Wooded clay banks and gravelly ridges are much to its taste. Openings made by the settler, with stumps in abundance, are a veritable happyland for the Woodchuck. In the Northwest, it so carefully keeps to the woods that its name is "Thickwood Badger."

The home range of the individual is very limited in one sense. The tracks and the destruction around the doorway of a Woodchuck's den show that ordinarily it does not go more than 100 yards from home.

John Burroughs writes me: "I find that Woodchucks are not the rovers that some think they are. I captured one this year in the same place where I have been laying for him for three years. It was a very dark old male."[13]

But a time comes when the Woodchuck needs a change; and he sets out to seek his fortune elsewhere, going perhaps a mile or more, before finding a location that suits his taste, and is without an occupant of his own tribe. This is the only migration known among the Woodchucks; it may occur at any time of the day or night, or at any season except in deep winter.

In the ground about my house, the species is well represented, but I never see a Woodchuck two years in succession at the same hole. A new den each year seems to be their plan of life—an annual—doubtless a spring—moving.

Numbers

It is doubtful if there is any other animal of the size as numerous in America to-day as the Woodchuck. There is much reason for believing that the species has increased with the settlement of the country.

During my early days in Ontario, Woodchucks were considered common, but I think that there were less than 20 on our 100-acre farm.

Walter L. Hahn states[14] that in Porter County, Ind. (400 square miles), where Woodchucks are very abundant, about 1,400 had been killed each year for the 5 years ending 1905, without appreciably reducing their numbers.

In Gaspé, Que., during 1924, G. G. Goodwin found the species plentiful. He says: "Woodchucks were commonest in the open country along the coast. On a warm summer evening after heavy rains, I counted 15 of them sunning themselves on old tree stumps in one corner of a field."[15]

In Lewis Co., N. Y., 33 were captured in one large meadow during a ngle season by Drs. Merriam and Bagg.[16]

---

[13] Personal letter, Roxbury, N. Y., Oct. 11, 1920.

[14] Mamm. Kankakee Valley, Proc. U. S. N. M., 1907, p. 458.

[15] Journ. Mamm., Nov., 1924, p. 256.

[16] Mamm. Adir., 1884, p. 249.

On May 15, 1917, when I was visiting John Burroughs at his home on the Hudson, he told me that on the 100 acres about his summer home, Woodchuck Lodge, located in the western Catskills, in the July and August of 1916, he killed 60 Woodchucks. In one month, during 1906, he killed 80 on the same farm. The Dogs and neighbours killed at least 100 more that summer, so that here was a total of about 200 Woodchucks killed each summer on that same area, and yet no obvious reduction of the population resulted. The whole region about was similarly populated by Woodchucks. This implies 300 to the 100 acres, or 2,500 to the square mile.

If these figures apply generally, it shows that New York and New England with their 100,000 square miles of Woodchuck range, should have 200,000,000 Woodchucks; and the whole of the area possessed by the species, even discounting for sparse population, might easily contain 1,000,000,000 Woodchucks to-day.

It must be remembered, however, that, like all species, especially of rodents, its ranks are much subject to periodic fluctuations. Raymond S. Spears says:

"Like Rabbits and Hares, Woodchucks have years when they are 'everywhere,' and then follow years of scarcity. Waves of animal life sweep across the foothills of the Adirondacks from time to time. . . . So with Woodchucks. For a few years, they are hardly noticeable anywhere, then some summer, when the grass is mowed the meadows are alive with them."[17]

Just when these years of overabundance have taken place, is not on record. Whether they coincide with other species' high tide, or with sun spots, or with world epidemics, is not known.

Burrow—Home and Refuge

As will be seen, the existence of the Woodchuck depends on its den or burrow. This may be either in the woods or on the rolling pastures, but is by preference on the borderland between. Two principal types are described by Merriam:[18] "The first slopes at a moderate angle from the surface, and has a mound of dirt near its entrance; the other is more or less vertical for several feet . . . immediately below the surface, and no loose earth can be found in its neighbourhood."

These I have often examined. The difference is that the one with the earth pile was dug from the surface down; that without earth pile was dug from another burrow up to the surface. Or, in other words, one is finished, the other is not.

---

[17] Woodchuck Ways, p. 176.

[18] Mamm. Adir., p. 246.

Most burrowing animals, notably Chipmunk and Woodchuck, bring all the earth out of the entrance of beginning. Ultimately, the back door is opened from below, the earth pile at the other entrance is levelled by weather and hidden in grass; and the back or blind door becomes the front; unless the burrow is so successful that the owner keeps adding to the pile, and finally uses it as a look-out. But, in any case, he retains the blind door. It is so inconspicuous that, at 10 feet, it is easily overlooked; and many a Woodchuck, driven by Dog or Fox from his mound, gently puts out the top of his head from the blind door, and watches the vain mouthings of the enemy at the front.

The best descriptions of Woodchuck burrows that I know of, are by W. H. Fisher, of Cincinnati, O. My own observations, as far as they go, corroborate those of Fisher; therefore, I shall give a digest of his admirable paper. (Investigations. See References.)

He investigated 9 burrows between Sept. 20th and Oct. 10th, though not all the same year. One of the simplest styles is shown in Excavation I (Plate XXXV, p. 329), the most complex in H. He does not say whether these were the work of families or of solitary males, of recent make or old.

The longest was H: it gave a total length, including all galleries, of 47 feet, 11½ inches. The shortest was I; its total length was 6 feet, 8¼ inches. The deepest point reached by any, was 49 inches down. The burrows at the entrance were usually about 1 foot by 6 inches, but sometimes much larger; in one case, very near to 24 inches one way. (Almost certainly, however, this was enlarged by a Dog or Fox trying to get in.)

But always, they are speedily narrowed to a diameter of 6 or 7 by 4 or 5 inches. Most had two, some three, entrances; a few had but one. Most had indications of at least one earth pile at the door; a few had no earth pile, though there were signs of its former existence in the increased vegetation. One only had earth piles at all doorways, of which, however, it had but two. Some had a doorway concealed under shrubs or in bushes; in each case, this seemed to be the original door by way of which all the earth had been carried out.

The largest pile was 4 feet 9 inches by 4 feet 11 inches by 9 inches high. These mounds were evidently used as posts of observation.

I have long held the theory that many animals will plug their burrows behind them to elude pursuit; Fisher's observations on this point are conclusive. He thus relates his first investigation:

"One afternoon, the farmer, while ploughing over a field, high and level, in which corn had been raised, and from which the ploughshare threw up the nests of Jumping-mice, informed me that a Woodchuck had a few minutes previous gone down into a hole by a stump, standing far out in the field. I summoned our faithful Joe, and each of us, armed with a shovel, proceeded to the stump. Here we began to dig, following down the hole. The latter ran under the stump, ramified a little, and then ran horizontally some 2 feet below the surface for about 5 feet, and then descended rapidly nearly 2 feet more in an additional length of some 3½ feet. Not a sign did we see of our much-sought-for Woodchuck. . . .

"The next day . . . I found at the side of the ditch, and on a level with the passage which was about 2 feet below the surface, a new hole. Aha! Here it was the Chuck had hidden. But how was it that we saw no traces of this hole when digging? When we left the ditch, the place where this hole was, was a part of one continuous wall of sand, without break or check to indicate that any hole was there."[19]

More evidence was secured in another hole that he followed Sept. 30th: "At 12 o'clock," he says, "just one-half hour after the digging began, we came upon a live, robust Marmot, ready to do and die in his own defence. After reaching him, we watched him while a party was sent for a canvas bag. Meantime, the fellow gave us a specimen of his ability by filling up the hole in front of him, and thus disappearing from view. The time occupied in this operation was one minute."[20]

Conclusive evidence was furnished by an individual that he dug out on Oct. 10th. This one was watched again and again, plugging the hole behind him when exposed by the diggers. In half a minute, he could completely close it with earth so hard packed as almost to defy discovery of the tunnel.

In this we see the explanation of so many Woodchucks escaping underground even from enemies that were able to follow them.

Ernest C. Adams, discoursing on the subject, says: "Though a Woodchuck may have two or three burrows which he occupies at different times in a year, there is never more than one animal at a time in a burrow, except the mother with her young."[21]

W. E. Cram relates an incident of a Woodchuck that made his winter den in a hollow log.[22]

Most of the burrows opened by Fisher had one enlarged nesting chamber more or less lined. A few had none; one only, the largest and longest (see H in Plate XXXV), had 6. This is the home nest of the individual and the nursery of the young.

---

[19] Investigations, pp. 106–07.

[20] As above, p. 115.

[21] Recreation, May, 1902, p. 345.

[22] Amer. Anim., p. 158.

His Food and Drink

So far as I know, the Woodchuck does not drink; but, like the Rabbit, satisfies his bodily need for liquid with the juices of food-plants, aided, no doubt, by their sprinkling with rain or dew.

Grass and clover are undoubtedly the favourite foods of his kind; but he is perfectly willing to accept anything that man considers food, and to formally enter it on his bill of fare.

The meadows about his entrenchment furnish an ample variety of necessaries—all the essentials. But Woodchucks have the same love of change, adventure, and luxury, as so often leads their betters into trouble; and, although the 50 yards of his home ground grew food enough for his father's whole span of life, the distant man-made fields and gardens offer an irresistible lure to the new generation.

The little paths about his home are well worn, and easily followed in haste. But longer paths with Woodchuck finger-posts are slowly planned and made to the farmer's field. One of these, says Cram, leads through the grass "from one clump of clover to the next, and only too often to the bean patch or garden where it pleases him to eat out the tender inside of several cabbage heads in a single night.

"Beans he strips of leaves, pods and everything, and he is not averse to ears of corn and young pumpkin vines; in fact, there are few things raised in an ordinary vegetable garden which he does not occasionally exhibit a taste for. He is also fond of sweet apples and fruits of various kinds, frequently making his home in the orchard for the purpose of enjoying them."[23]

The list of his food stuffs steadily expands on study. Walter L. Hahn says: "I obtained a Woodchuck which had been 'treed' by Dogs in a sassafras bush, and, on examination, showed that its stomach was gorged with sassafras leaves.

"So far as I know, it is not a usual habit for the animals to obtain their food from trees."[24]

"Dr. Witmer Stone states that the Woodchuck sometimes eats cantaloupes."[25]

---

[23] Amer. Anim., p. 153.

[24] Mamm. Kankakee Valley, 1907, pp. 458–59.

[25] Howell, Revision, p. 13.

Speaking with the voice of a farmer who has suffered, A. C. Sisson, of La Plume, Pa., writes: "I have looked in vain for some one redeeming trait in this sneaking, grovelling curse to the agriculture of our State. He is a gross feeder, devouring nearly as much clover as a full-grown Sheep; he eats to give him strength to dig holes, and then digs holes to give him an appetite for more clover. He takes supreme delight in tearing the bark from young fruit trees, and will wipe out entirely a good-sized bean patch in a day."[26]

As Meat-eater

Personally, I never caught a Woodchuck feeding on flesh; but I never knew a rodent that would not, on occasion, add meat as a variant to its diet.

So that I was quite prepared to read in Godman, concerning his pet Woodchuck: "This Marmot would eat the parts about the joints of the legs of fowls, when thrown to him, and occasionally a small piece of salt-fish."[27]

A still more carnivorous lust is evidenced by the following, which was related to me by Ernest O. Leighly, of Hartville, O. He had startled a quail and her brood. One of the downlings ran down a Woodchuck hole. A moment later, the Woodchuck came out, licking his lips, and looking for the rest of the quail.

This incident is not conclusive, but is suspicious. We must, however, admit that it is unfair in any case to judge of a race by its degenerates.

The taste for animal diet is not, of course, wholly reprobate, even in a Woodchuck. Charles A. Gianini, of Poland, N. Y., offers some observations that ought to sink deep into the hearts of the heartless, who would destroy the fat and jolly Red Monk of the hillsides.

"This spring [1925]," he says, "we have had an unusual visitation of the large brown beetle known as the June bug; and I had noticed, about the entrance of various burrows, excrement containing undigested parts of these beetles. At first, I was suspicious that this represented the droppings of Skunks, but later I punctured a Woodchuck, with a 30–30 bullet, and scattered about, with blood and other matter, a quantity of parts of these same insects."[28]

Can He Climb?

In every part of America that I have visited, there is, in country places, a sort of unorganized club called the "corner grocery." In winter time, its big, pot-bellied stove gives forth a genial heat; and a sawdust box furnishes a target for the spitters. But the real heat of the place, and the real target for their finest shooting, are in certain current ideas. For example, let someone assert that "a Woodchuck cannot climb a tree." Then prepare for a storm—a storm which has raged in every sporting magazine, not once, but periodically, as well as in nearly every book of natural history, since the Woodchuck was discovered.

---

[26] Enemies of Poultry, Dr. B. Harry Warren, 1897, p. 518.

[27] Amer. Nat. Hist., I, p. 329.

[28] Journ. Mamm., Nov., 1925, p. 282.

The corner grocery scraps are soon forgot, but those in print endure. The last of these tempests—and it should be the final—appeared recently in the *Journal of Mammalogy*.

By way of résumé on the subject: In the 40's, John Bachman wrote: "They climb trees or bushes awkwardly."[29] In 1881, Dr. C. Hart Merriam wrote: "Woodchucks, when unmolested, and particularly during their youthful days, often climb 10 or 12 feet in shrubby and young trees that abound in low branches."[30]

In Life Histories, I recorded another case.

In the *Journal of Mammalogy* for Nov., 1922, enough nails are driven into the coffin of the trouble-starter to hold it in its final rest. A number of cases are given on the authority of good naturalists, such as Bernard Bailey, B. S. Bowdish, Oliver P. Medsger. And in his 1915 monograph of the genus, Arthur H. Howell summarizes the evidence as follows:

"All the species are mainly terrestrial, but the Eastern Woodchucks occasionally climb into trees and bushes. They are not at home, however, in such situations, and as a rule, may easily be dislodged. The tree-climbing habit appears to be more strongly marked in the Woodchucks of the Mississippi Valley than in those inhabiting the Atlantic States. Charles Aldrich, of Webster City, Iowa, has recorded an instance of a Woodchuck ascending an oak tree to a height of 40 feet;[31] and Dr. F. W. Langdon states that in Ohio he has seen one descend the perpendicular trunk of a large sugar maple, *head first*.[32] In Minnesota and Wisconsin, as I am informed by Vernon Bailey and H. H. T. Jackson, it is a common occurrence for Woodchucks to take to trees when pursued by Dogs."[33]

Yes, he climbs, good fellows of the "corner grocery"! Let's consider it settled.

---

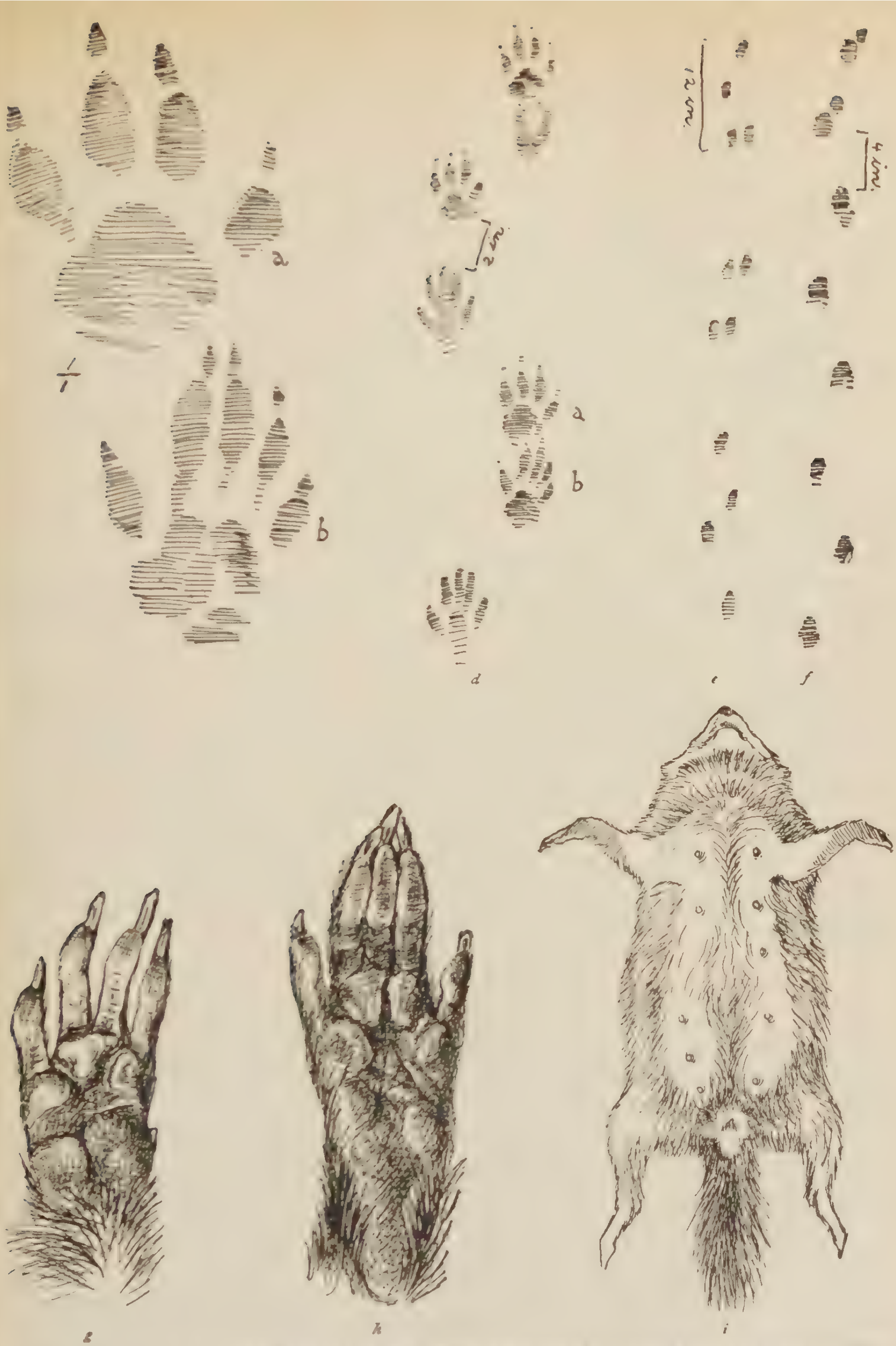
[29] Q. N. A., I, p. 19.

[30] Forest & Stream, July 7, 1881, p. 453.

[31] Am. Nat., XV, 1881, p. 737.

[32] Journ. Cincinnati Soc. Nat. Hist., III, 1880, p. 305.

[33] Revision, pp. 8–9.



Upper part is series of tracks made at Cos Cob, Conn. *a* is track of right fore foot; *b* of right hind. The series *d* shows track in walking; *e* and *f* show tracks speeding

g is right fore and *h* right hind of a small female (natural size). *i* is the same individual, taken on Athabaska River, May 28, 1907

PLATE XXXII.—TRACKS, MASTOLOGY, ETC., OF WOODCHUCK (*M. monax canadensis*)

CAN HE SWIM?

This seems to be a rule: All land creatures that run on four feet, swim naturally, and without learning; for the movements of walking are also effective in swimming. When the creature finds itself in the water, it naturally tries to walk out, and succeeds.

On the other hand, upright mammals, like man and Monkeys, do not swim naturally, because the upright position does not answer in the water. They must learn to swim, or drown.

Thus, the Woodchuck should be able to swim. At one time this ability was doubted, but evidence aplenty has turned up.

In the *Journal of Mammalogy*, May, 1923, pp. 105–07, Dr. Charles E. Johnson gives several instances of the Woodchuck voluntarily entering the water, and "swimming strongly and well."

In the November issue of the same Journal, p. 256, are additional cases furnished by John C. Phillips, W. E. Cram, and Col. Wirt Robinson. The last is, in some respects, the most remarkable. The Colonel says:

"In front of my home in Nelson County, Va., the James River is over 100 yards wide, and, at that particular spot, the river bottom is all on the north side, the south side being a precipitous, rocky bluff. In this bluff, there are a number of Woodchucks; but the vegetation—laurel thickets and large trees—does not furnish them with a food supply comparable to that on the cultivated land on the opposite side. They, therefore, frequently swim across, feast on corn, clover, melons, etc., and then swim back. I have several times seen them do this; and on June 18, 1899, I overtook one with a boat and captured it in the middle of the river."

FUR AND PELT

Since we must discuss the subject of possible use to man on the part of the Whistle-pig, I recall that, in my early days, the leather of his tough, white hide was in great demand for mit-facings, and for whip-lashes.

We used to prepare the leather thus: Wrap up the raw, fresh pelt with plenty of hardwood ashes on its flesh side. After two or three days, in a warm place, the hair slips off, or can be scraped off. Soak the skin then for a week in soft soap, and work thoroughly till it is dry and pliant. Failing the soap, a strong brine of salt and alum will serve.

His fur was utterly despised—indeed, no one believed that he had any—nothing but a sort of thin, coarse hair. In those days, Muskrat brought 5 cents; Coon, 25 cents; Mink, 75 cents; Fox, $1.00; Marten, $2.00—and of all these, there was abundance. What wonder that the Woodchuck pelt was lightly esteemed.

Now, what a change! Anything that even looks like fur is worth its weight in silver at least, and some of it twice its weight in gold. Taken at the right season, properly selected, and matched with care, we now think a "Marmot" (Woodchuck) coat is a proud and comforting possession.

John Burroughs wrote me from Roxbury, N. Y., Oct. 11, 1920: "I have a Woodchuck-skin coat which is a handsome garment, and greatly admired, made from skins which I collected. I have this season collected enough skins for a similar garment for Dr. Barrus."

As Food for Man

What a pity he was ever called Ground-hog. Notwithstanding the national importance of pork, and the popularity of sausage-meat, the name "Ground-hog" has prejudiced us against the Marmot; just as the single, accidental syllable "Rat" has hitherto barred Musquash (Muskrat) meat from our tables.

All who have studied Woodchuck-ophagy, begin with the warning: Be sure to cut out the kernels or glands which are found one in each fore leg, high up near the body. These are musky, and will surely impart their taste to the meat—will, indeed, spoil it for food unless they are cut out as soon as possible, after the animal is dead.

It is long since I tried roast Woodchuck. But my memory of it is that it resembled spring lamb, with just a suspicion of some strange, animal musk—a memory justified by the later testimony; for, as I recall it now, our roast Ground-pig was in full possession of his glands when he entered the oven; so that the warning hereabove given is much in point.

For those who would experiment, it is well to remember that there must be a vast difference between a nice, tender half-yearling, properly cleaned, de-musked, brine-soaked, pot-roasted; and an old fighting male, musky, tough, uncleaned, badly cooked. One is delicious, the other not fit for food. It is so with all animals.

As a Vocalist

Most of the rodents are vocally gifted. The Woodchuck, though with less of a reputation than the Red-squirrel or the Hoary Marmot, is yet noted for his varied whistles and calls. His names "Siffleur" (Whistler) and "Whistle-pig" are in evidence of popular recognition.

The best-known of his whistles is the fearless trilling from his den, when he dives and defies boy and Dog to come and "do their darndest." On these occasions, he also chatters and grits his teeth; but when he is at death-grips with a Dog or Dogs, he wastes no breath in useless sounds—he bravely fights in silence.

"Before leaving the hole," says George P. Dernier, "the Chuck always whistles; the same whistle being mistaken many times for a bird.

"He always utters a short, sharp whistle, following with a chuckling sort of warble; although this warble cannot be heard unless the hunter is quite close to the hole."[34]

The veteran naturalist, Raymond S. Spears, says: "The hunter finds several types of Woodchucks. I remember Woodchucks which always whistled when alarmed. For 12 or 15 years, this family lived in holes on the Waghorn place. Whenever one approached, the startled animal would whistle shrilly."[35]

Similarly, Angus Ballard writes, concerning the summer whistling of the Woodchuck: "The call begins with an extremely shrill, short whistle, followed by one of lower pitch, given with a sort of chuckling sound and a diminuendo ending. It is rarely, if ever, heard except just at dusk, and then in the concealment of briers or other cover right at the mouth of the burrow. What purpose is served by this practice, I have never been able to determine.

"Often when surprised some distance from the burrow, and chased in either by a man or Dog, a Woodchuck, just as he goes into the ground, will utter a shrill whistle which is an abbreviation of the call above described. It has a saucy sound, and almost suggests a challenge to the pursuer; but is more an alarm call than anything else."[36]

To these, we may add the shrill, rattling whistle of alarm which bids the enemy keep off, or warns the distant neighbour of the foe; the low grunt or whine of mother and young in family confab; and the sound of menace made by grating teeth.

The climax of animal life is when the urge of springtime, bodily well-being, youthful vigour and love, combine to thrill the creature into doing his fearless best—to express the vast joy that, for a time, is filling and forcing him like wine. When this complicated, but simple, ecstasy enthrills and wholly dominates a sentient, valiant, vocal creature, like Weenusk, the overwhelmed *must* erupt in song.

---

[34] Forest & Stream, June, 1924, p. 360.

[35] Woodchuck Ways, p. 176.

[36] Woodchuck Game, p. 201.

Does, then, the Woodchuck sing?

The answer of the psychoanalyst is: He has no other choice; therefore, he does.

Does the Woodchuck sing, as sing the lark, the nightingale, the troubadour, the love-mad Romeo, when the thrill of love and springtime is enfevering his blood?

In the family *Sciuridæ* to which he belongs, he is the only member not credited with a song.

So far, no naturalist of record has told of it; nor have the farmers. They were not minded to find any good in the Red Monk who served distraint on every crop, grew fat on tithes, and scoffed at legal *nolle prosequi's* The hunters saw nothing but defiant grizzly hair, heard only what they wished to hear—the scornful, whistling war-cry, the rifle bullet's "pat."

Let us pray for better ears and better understanding. Then what we may expect, is hinted in a writing, old and still unique, by one who knew the Woodchuck from the other side—the side of friendly nearness, of sympathy, of daily, year-long closeness, without war; even as the soft and purring song of a Cat is never heard by those who hate, hound, and harm her, but soon enough by those who have won her little soul, have learned to sit, and, by silent, gentle fondling, proclaim their common kindness.

The article that gives the hint is from the pen of Dr. Albert Kellogg. "For the last 40 years," he writes, "the fact of the common Maryland Marmot or Woodchuck being able to sing like a canary bird, but in a softer, sweeter note, has been quite familiar to myself and others, who could be brought forward as witnesses.

"When a lad, we caught a very young Marmot. Mother, prudently forecasting care, etc., stoutly refused to allow the pet. Knowing the warm side of a mother's heart, we wisely resolved to try a little finesse in order to gain parental permission; so my older brother and myself took a saucer of milk, for we were sure if she saw it take hold with both infant paws like a little babe, as we had, the victory was ours. Brother got all things ready, and I insisted she should *just see it eat.* Her kind heart yielded; 'wouldn't have it die for the world; it took hold of the edge with both hands, so like a little child.' It was raised. It had a seat in the little high chair at the children's table full oft. Its earnest and restless concupiscent purr as it scented sweet cake and fragrant viands, was wonderful. At length, it became as familiar as the family Cat, and finally burrowed under the doorstep. My impression is now, and always has been, that it was a female. I used to watch the pet very closely to see how it sang, as children are apt to do. There was a slight moving of the nostrils and lips, and consequently whiskers, with an air of unmistakable happy or serene enjoyment. I question much if this is algether unknown to others, *always excepting naturalists.*"[37]

The Mating of the Monk

All the evidence at hand goes to show that the Woodchuck pairs. It is the testimony of nearly all observers that one, or else two old Woodchucks (never more) are found in each home den. Usually, two are seen in early spring, and when the allurements of the love season are over, the male—in most cases—goes forth to other scenes, though probably *not* to another mate. This is an inferior but popular style of monogamy. Pleasant variations of it are occasionally seen. Some Woodchuck fathers actually seem to stay, or return, home and divide with the mother the care of the young.

The mating ceremonies are believed to take place about the middle of March, that is, as soon as the waning of winter sets the Woodchucks free to resume active life. The tracks on the snow—if there is any at this time—show that the males make many and long journeys from home, are indeed greatly concerned about some special and important business in hand. What can it be, if not the all-urgent business of perpetuating their race?

There is, however, some evidence that the pairing takes place in the fall. First, in most species it is the recurrent sex-instinct that quenches the mother love, and drives the young forth to begin life for themselves; and the young Woodchucks do quit home in late summer, and go forth to seek their fortunes elsewhere. Second, the species is a profound hibernator; and many, if not most, hibernators, copulate in the autumn. This, indeed, seems to be a rule among hibernators whose gestation exceeds six weeks.

The Young

The young are born in the underground nest already described, about the end of April. They number from 2 to 8, but are usually 4 or 5; and, as with most rodents, are at birth very undeveloped and exceedingly small.

As they do not usually come out of the den till mid-June, it is probable that they are blind till a month old, and not strong enough to venture forth till 6 or 7 weeks after birth.

At this time, if at all, the father comes back to his family. I have heard of several cases; the most detailed was described to me by Robert M. Harrison, of Grand Rapids, Mich. He says that, on July 6, 1905, at a farm 3 miles west of the city, he saw and captured at one hole 2 old Woodchucks and

---

[37] Am. Nat., June, 1872, pp. 365–66, Singing Maryland Marmot.

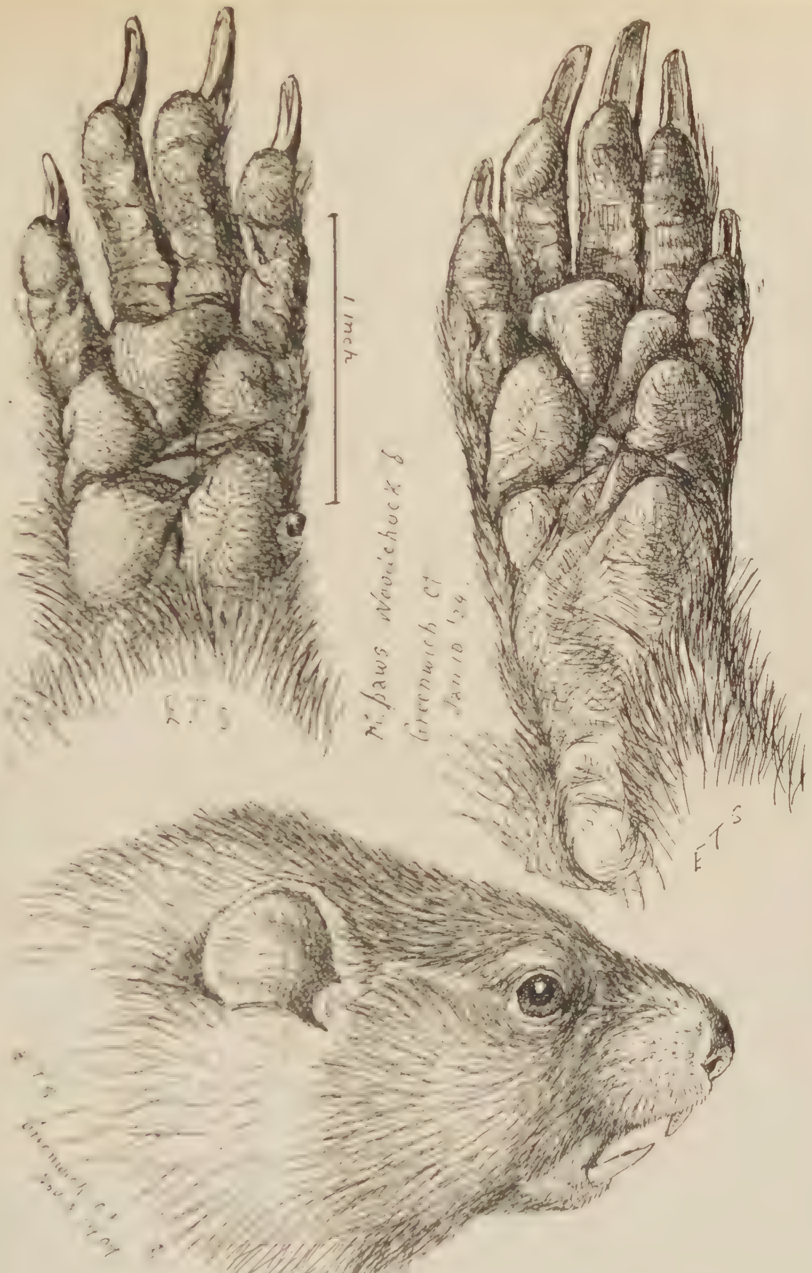


Plate XXXIII—Woodchuck ♂ details

5 young ones. He had seen 8 young ones late in the afternoon; the smaller old one was with them. He several times saw the mother come out and look around, then utter a sort of growl that brought the young out.

One day, at 5 o'clock in the morning, he saw both parents with the 8 young out together feeding. The mother came out first and called; the father came out, then went back, and brought out all the young ones. When they found that Harrison was near, the mother—that is, the smaller parent—uttered a low groan, that sent the family down below. They often chattered, but he never heard them whistle.

The young begin to eat solid food as soon as they are old enough to come forth and find it. They do not usually go far from the burrow at this time, but Bachman records[38] a case which also gives interesting light on the devotion of the mother.

"Whilst hunting one day (said a good friend of ours, when we were last in Canada), I came across a Woodchuck . . . with a litter of 6 or 7 young by her side. I leaped from my Horse, feeling confident that I could capture at least one or two of them, but I was mistaken; for the dam, which seemed to anticipate my evil designs, ran round and round the whole of her young 'Chucks,' urging them toward a hole beneath a rock, with so much quickness, energy I may call it, that ere I could lay hands on even one of her progeny, she had them all in the hole, into which she then pitched herself, and left me gazing in front of her well-secured retreat, thus baffling all my exertions!"

Another evidence of Woodchuck devotion is supplied by E. W. Reynolds, of Winsted, Conn. An old Woodchuck had her den near the house, and was much persecuted on account of depredations on the garden. Finally, she decided to move. She was seen and fired at; the rifle ball wounded her. Then it was clear that she carried a young one the size of a Rat. In spite of her wound, she carried her little one off 150 yards to a place of safety.[39]

By the end of August, the young Woodchucks are nearly full-grown—old enough to think they are able to care for themselves. The family breaks up; at least, the larger number scatter, to burrow on their own account.

Bachman mentions that "when the young are a few months old, they prepare for a separation, and dig a number of holes in the vicinity of their early domicile, some of which are only a few feet deep, and are never occupied. These numerous burrows have given rise to the impression that this species lives in communities, which we think is not strictly the case."[40]

---

[38] Q. N. A., I, pp. 21–22.

[39] Personal letter, May 28, 1910.

[40] Q. N. A., I, p. 23.

Ground-hog Golf

Youth is playtime with all the world. A few animals, like the Cougar, or Badger, continue so young at heart that even in old age they are ready to play. But no one has recorded a group of old Woodchucks assembled for a game or play of any kind. It is natural to suppose that all of the young ones do indulge, and yet only once do I find an account of such a pastime.

Charles A. Gianini, of Poland, N. Y., was fortunate in being witness of a Woodchuck game, which was more truly pool than golf, since the object apparently was to hole your opponent rather than yourself. He says:

"On the morning of May 9, while returning home after an early tramp in the woods to note the new arrivals in the way of birds, a friend and I suddenly came in sight of a pair of Woodchucks at play. We had not yet come out of the edge of the woods, and the animals were at the mouth of their burrow in a large meadow some distance away. They would sit up, take hold and wrestle; and we noticed that when one was thrown, he usually landed in the hole and disappeared from sight for a second or two. We watched this performance for a considerable time, and at first thought it accidental when one Woodchuck or the other landed in the opening, but it was repeated too many times not to have been intentional. . . .

"The Woodchucks were probably the young of the previous year. . . .

"I have watched Woodchucks a great deal . . . but never before have I seen them at play."[41]

Monax—His Calendar

Throughout the autumn, old and young are busied storing up food, not in warehouses or vaults that robbers might rifle, but as fat in their own skins—fat that will keep them doubly warm till absorbed. Also, their winter nests are warmly lined, and placed far below reach of the frost.

About the last of September, with little regard for weather or food conditions, they retire underground, to be seen no more that year. The Woodchuck is a "Seven-sleeper," as the country folk say, which pleasing and suggestive phrase may refer to Grimm's story of the Seven Dwarfs who slept for years in the cave, or may mean that he is one of the seven animals on our list that hibernate. I doubt not that the idea has been kept alive by the phrase, which owes its vitality to its appealing alliteration, and by the happy mechanism of its syllables, rather than by any body of known facts behind it.

---

[41] Forest & Stream, June 10, 1911, p. 899.

The annual subsoil trip of the species is scheduled for Sept. 30th in Connecticut, a little later in Maryland, a little earlier in Maine. As has been pointed out, in the North, he goes down in the autumn equinox, and reappears in the vernal ditto. I have, however, a note of one seen out at Greenwich, Conn., on Oct. 17, 1908; and W. E. Cram relates the trapping of one which was active on Nov. 1st in New Hampshire.[42] But such are exceptional, and usually these pioneers of a new way pay the penalty of overzealous reformers.

All investigations hitherto have proved that, sleeping in each winter den, there is either a solitary very young one, or a very old one, or else a pair—possibly the pair of last season, reunited as soon as it was the pleasure of the lady to reunite.

Bachman says:[43] "In the summer of 1814, in Rensselaer County, in the State of New York, we marked a burrow, which was the resort of a pair of Marmots. In the beginning of November, the ground was slightly covered with snow, and the frost had penetrated to the depth of about half an inch. We now had excavations made, in a line along the burrow or gallery of the Marmots; and at about 25 feet from the mouth of the hole, both of them were found lying close to each other in a nest of dried grass, which did not appear to have been any of it eaten or bitten by them. They were each rolled up, and looked somewhat like two misshapen balls of hair, and were perfectly dormant." He implies that they were clearly male and female.

The Hon. Daniel Wadsworth relates, concerning the tame Woodchuck that he kept for two years at Hartford, Conn.: "Winter coming on, the box was placed in a warm corner, and the Woodchuck went into it, arranged its bed with care, and became torpid.

"Some six weeks having passed without its appearing, or having received any food, I had it taken out of the box, and brought into the parlour. It was inanimate, and as round as a ball, its nose being buried, as it were, in the lower part of its abdomen, and covered by its tail. It was rolled over the carpet many times, but without effecting any apparent change in its lethargic condition; and being desirous to push the experiment as far as in my power, I laid it close to the fire, and having ordered my Dog to lie down by it, placed the Woodchuck in the Dog's lap.

"In about half an hour, my pet slowly unrolled itself, raised its nose from the carpet, looked around for a few minutes, and then slowly crawled away from the Dog, moving about the room as if in search of its own bed!

---

[42] Amer. Anim., p. 158.

[43] Q. N. A., I, p. 22.

I took it up, and had it carried downstairs, and placed again in its box, where it went to sleep, as soundly as ever, until spring made its appearance.

"That season advancing, and the trees showing their leaves, the Woodchuck became as brisk and gentle as could be desired, and was frequently brought into the parlour. The succeeding winter, this animal evinced the same disposition, and never appeared to suffer by its long sleep."[41]

GROUND-HOG DAY

The Woodchuck sleeps in complete torpor for weeks. But a popular superstition has it that each year, on the 2d of February, he comes out into the day. If he then *sees his shadow on the snow*, he retires for another six weeks' slumber. If, on the other hand, no shadow is visible, he continues more or less active until spring.

This superstition seemingly originated among the Negroes of the Eastern Middle States, and has this much of truth for foundation: The Woodchuck sometimes comes out as early as the first week in February. If at that time the sun shines brightly on the snow, it means frosty weather, and forecasts a late spring. On the other hand, *no snow* and low-hanging rainclouds, are evidence of an open winter; and that fosters an early activity on the part of the Woodchuck.

It must be obvious to the reader that I am trying hard to justify the picturesque popular notion; our lives and literature would be richer if we had more of such. Never let any biologist make you forget that Feb. 2d is Ground-hog Day.

SPRINGTIME

The spring awakening of the Woodchuck seems to have little to do with any of the essentials by which it is supposed to be guided, namely, weather and food. Merriam says:[42] "The remarkable circumstance has already been noticed that the Woodchuck often retires to winter quarters, when surrounded by an abundance of food, and during the continuance of fine warm weather; but still more surprising is the fact that he generally emerges from his hole, and tunnels to the surface while the ground is buried in snow to the depth of several feet, and when no green thing is to be found upon which he can feed. He not only comes to the surface, but makes long journeys in various directions over the snow-covered land, and is apt to continue these apparently aimless pilgrimages night after night, until the fast-melting snow

---

[41] Q. N. A., I, pp. 20–21.

[42] Mamm. Adir., p. 242.

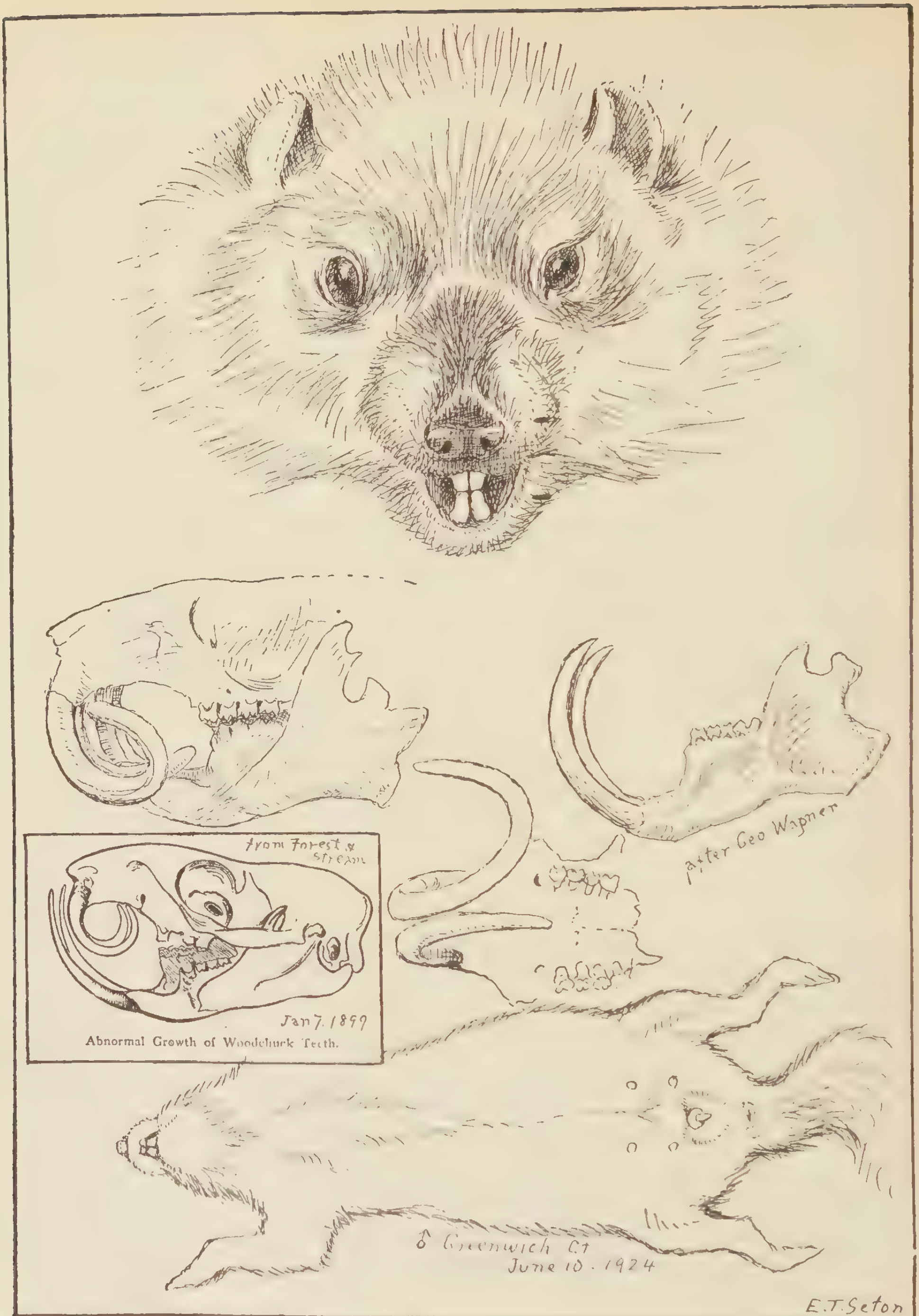


Plate XXXIV. — Woodchuck-mastology & freak teeth

enables him to reach the much-coveted grass, which has been kept fresh and green in places by its heavy covering."

Similarly, J. Dewey Soper testifies that in Canada, Woodchucks "make their appearance again in the spring, often under very trying conditions. I have known them to dig out through several feet of snow on a side hill early in March, and then to wander widely about on the snow, leaving tracks like miniature Bear tracks. They are now as alert as they were phlegmatic during the mellow days of autumn. They travel restlessly far and near, exploring old dens, and sinking shafts down through the snow with marvellous accuracy to some haunt of former years. One individual which I once trailed in early March, had located through the snow, and reopened at least a dozen holes within a radius of 200 yards along a wooded ridge."[46]

Of course, now is the time when his great store of fat is of service. Doubtless, this is absorbed during the weeks of scarcity in the early spring.

The warm, bright days with greening grass come on, the cold and the snow are gone. The Woodchuck sits at the door of his cell, enjoying to the full the good things of life, and *possibly* giving expression to his joy in a way that is worthy of happy, higher beings. Well-fed, unafraid, revelling in the warm sun, stretched prone, or rearing back against a bank, his limp limbs drooped in sensuous sloth, he rejoices in the spring wine of the air and yields —we believe—to the subtle, vital thrill which stirs the hidden springs of song.

ENEMIES

In considering the enemies of a successful creature like the Woodchuck, it is natural to assume that disease and insects come first, earliest, and are worst on the list. Apparently, it is not so. I find no record of plague or epidemic taking toll of the Monax race. Nor does it seem to suffer from insects. Even the *Cuterebra*, for some strange reason, lets it alone, and the mosquito bloods it not. If Monax would share with us his secret of immunity, it would compensate for many rows of ravage in the bean-yards and the clover by the road.

There is no Weasel, hawk, or owl that levies rack-rent tribute, or holds him in the grip of fear. The Badger enters not his realm. Almost alone in this is he: that, barring man, the grim Red-fox is his chiefest foe.

Early and late, in field and woodland, Reynard pursues the fat, gray Whistler. Aiming first to take him in a match of wits, he scans the far field; and marking Weenusk basking at his earthworks door, proceeds to circum vent him by a well-known hunter plan—the very same as that by which the Coyote takes the Prairie-dog, and the Eskimo the Caribou.

---

[46] Journ. Mamm., Nov., 1923, p. 248.

One who saw it with his own eyes, has described it fully:[47] A fat and cautious Woodchuck sits contentedly at his den door. A pair of prowling Foxes mark him from some distant rise. Without a word of planning, we may believe, and yet with perfect understanding—for they have done it oft before—the bigger Fox trots openly and not too near, across the Woodchuck's view. Fat Monax waits till it is evidently time to go below.

Fox No. 2 now rushes up and hides by the hole. Fox No. 1 goes slowly on. In a few minutes, the Woodchuck peers cautiously out, sees the first Fox at a safe distance, and boldly mounts his lookout. In a flash, the second Fox is on him—a vigorous shake ends Chucky's life—and the first Fox comes back for his share of the feast.

But, however, deep in his sanctuary, Monax is not wholly safe from Reynard. W. E. Cram goes on record with a tale that shows that even earthworks, the unanswerable, have an answer. "In the winter," he says,[48] "when the ground is unfrozen, Foxes will even dig them out of their winter quarters, and kill them in their sleep. They dig them out in warm weather as well, though I fail to see how they ever manage to catch up with so accomplished a burrower in an underground race."

Furthermore, he piles on facts, thus:[49]

"Last April, on a windy afternoon of bright sunlight, I saw a big dog Fox hard at work digging out a Woodchuck's hole on the slope of a sandy hillock at the edge of a meadow.

"Every few minutes, he would back out of the hole, and, shaking the loose earth from his yellow fur, look intently across to the other opening of the burrow, as if expecting at any moment to see the Woodchuck try to make his escape by way of the back door. A little distance away, a Woodchuck was signalling the dangers to any others of his kind that might be within hearing; *he* was safe enough at all events; the hole beside which he was sitting, was ringed in by corded beech roots with an entrance much too narrow to admit a Fox."

We have seen in the section on Burrows, how the astute Woodchuck baffles the "man with the spade" who would slay him in his safe refuge. In further illustration of this, Cram says:

"If their den is dug out, the Woodchucks often manage to escape by burrowing off through the soil, after the manner of Moles, filling up the holes behind them as they move along, and evidently not coming to the surface until sufficient time has elapsed to ensure their safety; though how they manage to avoid suffocation in the meantime is a question difficult to answer."[50]

---

[47] Leoren D. Ingalls, Forest & Stream, Dec., 1923, p. 700.

[48] Amer. Anim., p. 159.

[49] As above, pp. 267–68.

SANITATION

As soon as an animal develops an elaborate home, it must develop sanitation, or suffer from disease.

Dr. J. D. Godman says of the present species: "There is no animal so perfectly cleanly in its habits as this Marmot. . . . However numerous they may be in any vicinity, their excrement is not seen, nor any offensive odour perceived. Whenever the calls of nature are felt, this animal seeks a spot at some distance from his dwelling, and having dug a hole of two or three inches in depth, and performed his evacuations, he covers it up with extreme care; and, not content with placing a thick layer of earth over it, he presses it, or rather rams it down with the end of his nose, striking with a force which seems very extraordinary when thus applied."[51]

Some creatures that fear neither weather nor foes, go forth into the air to drop their dung. There are many times when the Woodchuck cannot well do this, and to meet the difficulty it has invented a dry earth closet. Merriam points out that the main gallery of the Woodchuck's burrow commonly terminates in a little pocket, where its excrement is found buried.[52]

From time to time, this is removed, and "the mounds in front of the large holes frequently, if not generally, contain accumulations of the animal's excrement, and in one case, I removed fully half a bushel from a single mound."[53]

These midden-heaps of the Woodchuck are likely to furnish much light on the history of the individual, just as the midden-heaps of the Paleoliths are our principal histories of their makers. Every scrap of bone or undigested food will tell a little story to those who can read such things.

In a nest of the long burrow, Fisher found the skull of a Woodchuck. "This find," he says,[54] "appeared to contradict the assertion made by a farmer that Marmots would never live in a burrow where a Marmot had died."

The following suggestive observations are offered by W. E. Cram:

---

[50] Amer. Anim., p. 153.

[51] Amer. Nat. Hist., I, pp. 328–29.

[52] Mamm. Adir., p. 247.

[53] As above, p. 246.

[54] Investigations, p. 115.

"It is no uncommon thing," he says,[55] "to find the bones of these animals in hollow logs and similar places, showing no signs of having suffered a violent death. A careful observer of Nature . . . told me that he had once seen a Woodchuck, apparently very old and feeble, laboriously digging a shallow hole in the soft earth; and that on returning, some hours later, he had discovered him curled up at the bottom of the hole quite dead, undoubtedly having died of old age after digging his own grave and crawling into it. He believed this to be a regular custom with them, and said that he had met with a number of people who asserted the same thing."

Tame and Kind

Am I partial to the Woodchuck? Yes, naturally so. I never see one in my field without getting a thrill of pleasure, a surge of admiration enhanced by respect. I see in him a character, simple and brave. He looks like a little, old darky squatter in a gray mantle, with red-brown shirt and stockings peeping out.

Of his bravery we have already heard. But is he intelligent? Alas, no! The rodents are low in the scale of wits, and he is low among rodents. His efforts in the world of brains are seen in his cleverness at keeping his fat body intact within his grizzly hide. He is not hard to trap or poison. He seems a recluse, devoid of social tastes or life. And yet we come suddenly on the puzzle of abundant proof that he makes a winsome pet.

Some 80 years ago, old Godman wrote of one he kept: "This individual was very tame, playful and cunning, having the freedom of the yard, and the privilege of performing all his operations unmolested. He was very fond of being handled and petted, and would play with great good humour, though in a clumsy and awkward manner.

"Everything fit to make a bed of, that he could get at, was sure to be carried underground; and when clothes were missed, which had been hung out to dry, it was only necessary to fasten a hook to a long stick and draw them out of his burrow. When this was to be effected, it was necessary to tie the Marmot up short, as he appeared to understand perfectly what was to be done, and was by no means willing that his bed should be rendered less comfortable.

"Although he would not attempt to bite the person engaged in removing his plunder, he would rush to the entrance, and endeavour to make his way in, as if to secure his prize, or remove it to a still greater distance. On one occasion, he carried off and stowed at a distance of 6 feet from the entrance, 8 pairs of stockings, a towel, and a girl's frock; and had he not been discovered in the act, would have made a still larger transfer of materials to form a more luxurious bed."[56]

---

[55] Amer. Anim., p. 155.

About the same time, Bachman wrote: "We are gratified in being able to communicate the following facts, related to us by the Hon. Daniel Wadsworth, of Hartford, Conn. 'I kept,' said he to us, 'a fine Woodchuck in captivity in this house for upward of two years. It was brought to me by a country lad, and was then large, rather wild, and somewhat cross and mischievous; being placed in the kitchen, it soon found a retreat, in which it remained concealed the greater part of its time every day.

"'During several nights, it attempted to escape by gnawing the door and window-sills; gradually it became more quiet, and suffered itself to be approached by the inmates of the kitchen, these being the cook, a fine Dog, and a Cat; so that ere many months had elapsed, it would lie on the floor near the fire, in company with the Dog, and would take food from the hand of the cook. I now began to take a particular interest in its welfare, and had a large box made for its use, and filled with hay, to which it became habituated, and always retired when inclined to repose.'"[57]

Recently, Dr. Raymond L. Ditmars, of the New York Zoological Park, wrote concerning a specimen in his care: "In a big collection like that in the Park, there are always a number of particularly tame specimens, which the keepers regard as especial pets. For the first time, however, we have recorded an absolutely tame Woodchuck. This species is usually timid, and resents any attempt at familiarity. The tame specimen was acquired last October. It follows Keeper Landsburg like a Dog, can be turned loose for hours without fear of wandering away, and more remarkable still, can be handled by children without the least show of impatience or nervousness."[58]

The Wail of the Worsted

The remorseless grinding of the great cosmic machine has pulverized uncounted thousands of different species; but ever and brutally has helped a few, made them hardier, keener, stronger—made them winners in the age-old fight. Of these is Weenusk-Woodchuck. He has found an answer to the problems that have wiped out Bear and Deer and Wolf. He lives and holds his ancient range; and holding—what next?

There is a law—no creature can stand still; he goes forward or back.

---

[56] Amer. Nat. Hist., I, p. 329.

[57] Q. N. A., I, p. 20.

[58] Zool. Soc. Bull., March, 1922, p. 44.

The Woodchuck, holding, is marching on. He has multiplied till the simple, sordid sons of the soil have raised their dirge of woe, raised the old calamity howl: The Woodchuck ravages our crops; we cannot fight him. Help us fight him or we, the salt of the earth, we, the feeders and builders of the nation, must fail. Help! Help! Help!

Don't we know it? Every legislature in New England and the adjoining States has heard the wail of woe:[59] Help! We can fight the Bear, the Wolf, and the Panther; but the Woodchuck is too strong.

About each Woodchuck den is a zone of desolated crops; and every year the dens are more numerous. More holes are digged each month, endangering Horses, riders, machines. Our traps, our Dogs, our guns are unavailing. The Woodchuck wins, and spreads his realm. Help, help! or we perish from the land.

All my life I have heard it; and, strange to say, there is much truth in it—a growing truth. What are we to do to meet the Woodchuck armies in their devastating march?

Three things there are—three simple answers, all complete. I give the last one first—it is so easy, so diabolic, so unfair, so final. It was the Biological Survey that invented and announced it: Drop down each hole a bundle of cotton waste, saturated with bisulphide of carbon gas. The occupants go calmly, mercifully, and effectually to sleep. They never wake up; their home becomes their grave.

There! I have told it, though I hate it. I hope it will soon be forgot.

---

[59] On Sept. 11, 1883, the Legislature of New Hampshire passed a bill authorizing a bounty of 10 cents for every Woodchuck killed in the State. The Hon. Charles R. Corning was Chairman of the Committee that reported the bill. Among his remarks, are the following helpful contributions to natural history:

"Your committee finds that the Woodchuck is absolutely destitute of any interesting qualities, that is, such qualities as would recommend it to the average inhabitant of New Hampshire. . . . Its body is thick and squatty, and its legs so short that its belly seems almost to touch the ground. This is not a pleasing picture. Its size varies all the way from those reared in Strafford County to the huge fellows that claim a homestead among the fertile farms of Grafton. Woodchucks have been known to attain a large size, even 15 pounds. . . . While the usual colour cannot be said to be a decided red, it is not Auburn, but more like Derry, which is next to Auburn. Your committee has now in mind the under side of the creature. The body, even in very young Woodchucks, is inclined to be gray—a very significant circumstance in the mind of your committee, when the total depravity of the animal is considered. . . . The Woodchuck, despite its deformities both of mind and of body, possesses some of the amenities of a higher civilization. It cleans its face after the manner of the Squirrels, and licks its fur after the manner of a Cat. Your committee is too wise, however, to be deceived by this purely superficial observance of better habits. Contemporaneous with the ark, the Woodchuck has not made any material progress in social science, and it is now too late to attempt to reform the wayward sinner. The average age of the Woodchuck is too long to please your committee. . . . The Woodchuck is not only a nuisance, but also a bore. It burrows beneath the soil, and then chuckles to see a mowing machine, man and all, slump into one of these holes, and disappear. . . . Your committee is confident that a small bounty will prove of incalculable good."

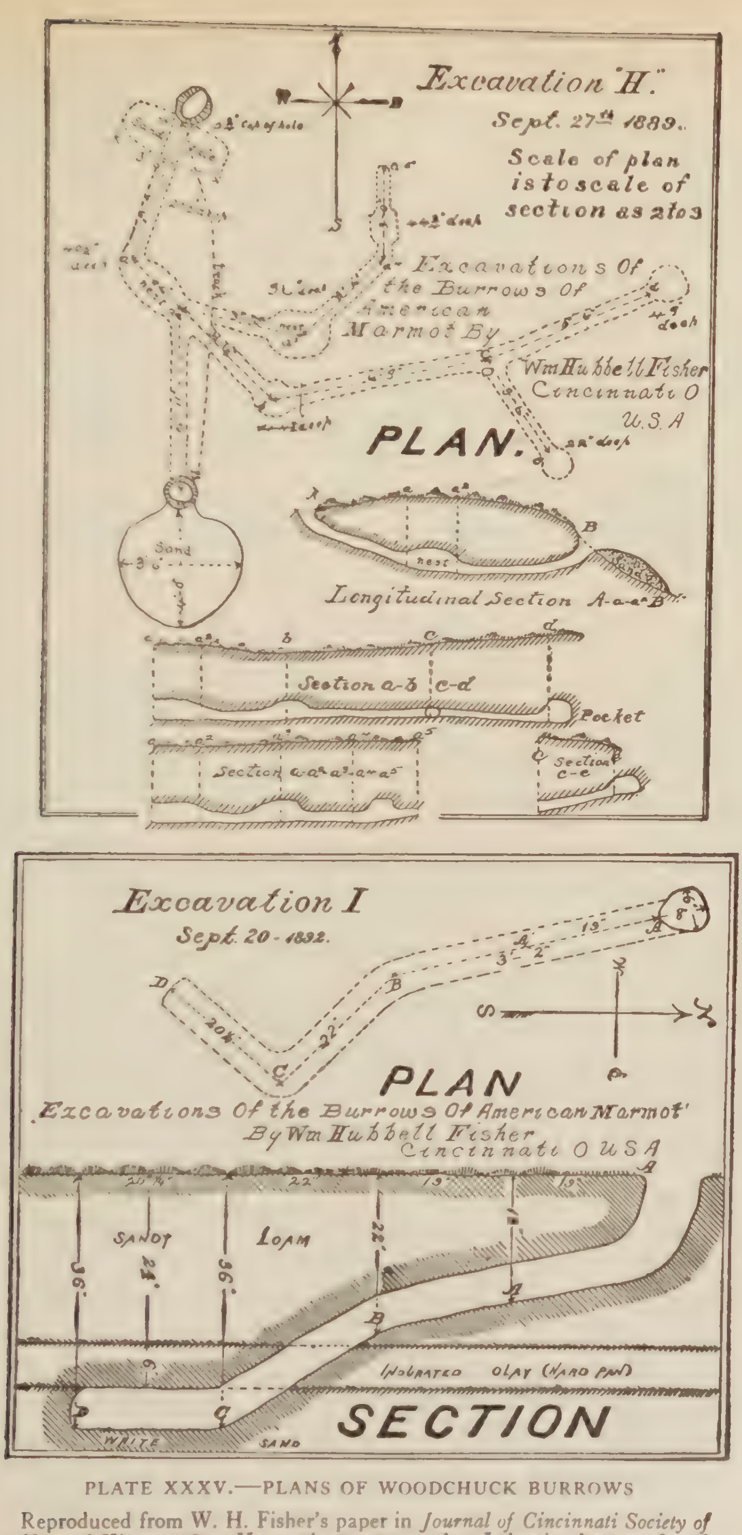

Excavation "H."
Sept. 27th 1889.
Scale of plan is to scale of section as 2 to 3
N
S
E
W
Excavations Of the Burrows Of American Marmot By Wm Hubbell Fisher Cincinnati O U.S.A
PLAN.
Sand
nest
Longitudinal Section A-a-a² B
Section a-b c-d
Pocket
Section a-a² a³-a⁴ a⁵
Section c-e
Excavation I
Sept. 20 - 1892.
PLAN
Excavations Of the Burrows Of American Marmot By Wm Hubbell Fisher Cincinnati O U S A
SANDY
LOAM
INDURATED CLAY (HARD PAN)
WHITE SAND
SECTION

PLATE XXXV.—PLANS OF WOODCHUCK BURROWS

Reproduced from W. H. Fisher's paper in *Journal of Cincinnati Society of Natural History*, 1893. H was the most complex, I the simplest one found

The second plan is—to use the creature. Bring economic pressure to bear; that is, make it pay to destroy him, by creating markets for his fur, his skin, his meat—and his one thing more—a something that I shall treat in another section, which is indeed my number 3.

This is that last and weighty thought: Do not ascribe new values, but recognize values already known. The Woodchuck is the last game beast in the East that is still abundant, and impossible to exterminate; a source of food, fur, and sport; the stalker's prey, the marksman's quarry; plentiful and in no danger of extinction; the killing of which is a joy and a little profit to the hunter, and a joy and a blessed relief to the farmer who is attempting to claim the ancestral lands of Weenusk.

How it is done, under what rules, and with what zest, is better told by others—sportsmen who have followed this huntercraft, and sing its praises.

The New Sport—Chuck-hunting

As long ago as 1898, Angus Ballard realized and wrote of the Chuck hunt. Those who would follow in detail, will find his experiences set forth in *Recreation*, Sept., 1898, pp. 200–01. In *Field & Stream*, June, 1921, pp. 154–55. Capt. Paul A. Curtis. Jr., gives further information. I give a condensation of their accounts.

The open season is August and September. Although there is no written law on the subject, these limits are imposed. Before August, the crops are standing in the field, and the young Chucks are not big enough to be game. After September, the wary creatures go down for their winter sleep.

This sport is essentially a field-glass and rifle pursuit. The glasses are as necessary as in Highland Deer-stalking. The open hillsides on which the old Chucks range, should be searched a quarter mile away for basking or feeding Chucks. And the hunter must realize that the Chuck also is forever scanning the landscape, and has the advantages of being a smaller animal and motionless.

It is seldom that one can get within 75 or even 100 yards of the quarry; and then only after a long, stealthy approach that would tax the power of a Scottish Deer-stalker. Even the youngsters of the year are at this time as wary as Antelope, and keen-eyed as hawks. Every few minutes, they rise up to scan the offing; and the slightest change in the view, a new unaccustomed shape, a shaking bush, a tap on a fence rail, a whiff of man-scent, is enough to send the Gray-coats bounding into their earthworks' safety, to be seen no more that day.

If, however, the approach has been perfect and the rifleman is within 100 yards, he must make a faultless aim, for the mark is but 8 inches square. Elevation, line, wind, kick, and refraction must all be perfectly appraised; nothing less than a telescope sight will meet so fine a test. And, if at the crack, the dust puff high or low or right or left—says, "Missed!"—the Woodchuck scuttles home. One shot is all the simplest of them lets the gunner try.

One great advantage of Woodchuck stalking is that the creature is a daylight animal, and a "fine-weather bird." His favourite feeding times are soon after sunrise and again late in the afternoon. But he may be seen and hunted at any hour, provided the weather be fine.

Men who hunt Deer or Moose—if they have any conscience—are haunted by the thought that they are bringing a big, harmless animal ever nearer to extinction; and too often the Deer hunter must count on war with these whose lands he hunts on. The Chuck hunter is under no such burden of unpleasant thought. The farmers everywhere welcome him, and do all in their power to crown his stalk with success; and as to Chuck's extermination, there is no likelihood of it.

The Woodchuck riflemen of New England maintain that it is harder to secure an old Woodchuck than to kill a Deer; and a man who can get 4 Chucks in a day by fair stalking has a better claim to hunter laurels than he who kills a Moose.

It is worthy of note that Dogs have no place in a Chuck hunt.

His Way of Life

A sun-child, is Weenusk; and all his goings are in keeping with the marching of Old Sol. Cram records him "coming out to get his breakfast soon after sunrise, while the dew is still on the grass, at which time I fancy he makes his most substantial meal, though he may occasionally be seen feeding at any time of day. At noon he is pretty sure to make his appearance above ground for luncheon; but apparently spends more time then in sunning himself than in eating. Late in the afternoon, he again shows himself, and feeds until nearly sunset, when he descends into his burrow for the night."[60]

At one time, I too considered the exemplary Woodchuck strictly a creature of daylight, sunlight preferred. But many recent observers have discovered evidence that in warm weather the Woodchucks come out by night, especially by moonlight; and are partial to a twilight ramble.

---

[60] Amer. Anim., pp. 152–53.

Out of an amplitude of experience, Angus Ballard writes: In feeding, the Woodchuck "rarely goes 100 feet from his 'hole,' more commonly not 50 feet away; and at short intervals raises his head to see that everything is quiet. At longer intervals, he rises on his hind feet, and makes more extended observations. Any unfamiliar sound or motion will cause him to stop feeding, and look around; and its repetition will send him scurrying underground in a moment."[61]

"Commonly," says Raymond S. Spears, "an alarmed Woodchuck dives into its hole. They run in, turn around and come back, crouching close to the entrance to listen. I have run up and stood over the mouth of a hole, and killed several as they returned."[62]

Proof that Weenusk does not lose his head, and knows how to play "freeze," "squat," and "lay-low," as well as do wiser wild things, is seen in this incident told by E. A. Leopold: "A few months ago," he says, "I surprised a Chuck some little distance from his hole, in a field where the grass was short. He flattened himself down, as close to the ground as he possibly could, and waited for me to walk by, which I did not do, as my object was to make a picture. . . . I reversed the plate-holder, and walked slowly toward the Chuck, with the intention of making a second exposure at a shorter distance, but when still about 30 yards away, he made a run for his hole; and another Chuck, which was sitting up on his haunches near by, ran in with him."[63]

Though not the equal of the Fox in a match of wits, he is wise in the little ways of the woods. He has the small wisdom of the Chinese peon, with frugality and a one big, simple answer to all present dread.

Panoplied in such, his race is far indeed from ending. In those, that now I call my Woodchuck Days, the Bear, the Deer, the Beaver, the Wolf, and even the Porcupine, were gone; but the Woodchuck throve, as still he thrives. Without the cunning, the speed, the strength, the armament, or the prowess of any of these, he still has a secret better than all, that gifts him with power to hold his own. The secret of his life—the sum of his wisdom is this—keep close to the ground. In time of stress, he flies to Mother Earth. This, indeed, is wisdom, for our wise men tell us all flesh is earthborn, Antæus-like, that nations die as surely as they quit the soil. Here man himself might learn a lesson; while others pass away, the Woodchuck's race yet lives, and thrives, and holds its ancient range.

---

[61] Woodchuck Game, p. 200.

[62] Woodchuck Ways, p. 176.

[63] Forest & Stream, Oct. 9, 1909, p. 576.

SONGIDAZZY, LITTLE STRONG-SOUL

With one voice, friend and foe of Weenusk proclaim his unflinching courage.

This is the testimony of Cram: "His attitude toward his enemies," he says, "is apt to be one of obstinate defiance. Other wild animals of his size, almost without exception, prefer, when in the proximity of houses, to remain in hiding during the day, only venturing out under cover of darkness. But the Woodchuck often digs his hole within a few rods of a farmhouse, and swaggers boldly about the garden at midday, helping himself to whatever appeals most strongly to his appetite.

"When pursued, he scrambles in frantic haste for his burrow, his black heels twinkling in the sunshine as he goes; but on reaching safety, he is likely to turn about and thrust out his nose to chuckle defiance at his pursuers. If cornered, he is always ready to fight anything or anybody, and a Dog lacking experience in such matters, is likely to get the worst of it, for a Woodchuck's incisors are weapons not to be despised."[64]

So also says Hervey Lovell, writing in *Field & Stream*:[65] "Backed into his den, he is no mean antagonist for any Dog. Many hounds are afraid to close in to death-grips with an old Chuck."

Godman tells of the tame one which he kept for a long time, that it was exceedingly fond of bread and milk. If the Woodchuck saw the Cat fed on this dish, he would "become almost furious, and never desist from his efforts until he has broken his chain, when he would rush to the spot, drive off the Cat by a severe bite, or bite the person who attempted to withhold him from the dish. Yet, on other occasions, he did not interfere with the Cats, even when feeding within his reach, though he would at any time bite them if they came immediately in his way."[66]

In the *Journal of Mammalogy* for Feb., 1924, p. 68, Ernest G. Holt tells of a wandering Woodchuck remote from a burrow, and "bayed in a briar patch by Dogs . . . the Woodchuck licked the Dogs."

A strange instance, showing how a Woodchuck's courage proved her undoing, is offered by Charles A. Gianini, of Poland, N. Y. From a lookout he described a far-off Woodchuck. He overshot. "At this," he continues, "she ran for her burrow and disappeared, and here her strange performance commenced. She reappeared at the entrance. I shot again and missed, and she took to her heels and started running up a small depression in the hill straight toward me, and I finally killed her about 10 feet away. Just over the crest of the hill behind me were some burrows; and for these, this Woodchuck was undoubtedly headed. But why she left the security of the first burrow and ran 60 or 70 yards up the hill toward me, will always remain a mystery. Possibly there was an occupant in the first hole to whom the other was unwelcome."[67]

---

[64] Amer. Anim., p. 153.

[65] Nov., 1918, p. 559.

[66] Amer. Nat. Hist., I, p. 329.

George P. Dernier credits the Red Monk with cunning measured to his valour, and says: "The Woodchuck is often called a timid animal, yet he proves a vicious foe for any Dog that happens to corner him. He will fight until exhausted, then lie quiet; and I often believe that this is part of his game, as one will notice that he keeps a constant watch on the Dog who is waiting for another move from his victim; and when he renews the fight, he seems to have more vigour and courage than ever; the Dog is not always the victor."[68]

In the Eastern States, the Woodchuck still continues in numbers, despite the efforts of farmers who do not appreciate the æsthetic beauties of a philosophic life—who are so small and bigoted, indeed, that they would rather kill a Woodchuck than lose a Horse or an acre of clover.

Here, by choice, his home is on the half-tilled farm whose food allure is ample offset to the big Dog and the small boy—the dread combine that takes its yearly toll of the Weenusk race.

Upon the whole, he had little to fear from any but these—the boys and their ever-present auxiliary, the House-dog. Many times, as I now recall with overlong delayed remorse, we played a boyish, fiendish part. That same old Dog, by cutting off some Chuck afield far from his fortress, would drive him into a treacherous hollow log or burrow just begun. Here he needs must turn to fight—for the Woodchuck, though wisely ready ever to retreat if possible, will *never surrender*. No, he is a fighter, and fight he will, with the courage of a hero, both Dogs and boys innumerable; whistling his shrill alarm, desperately grating his teeth till their splinters fly, seizing on anything, club or Dog, that comes in reach; defying all, till the brutal twisting-stick entangled in his fur gives the unexpected jerk that throws him on the mercy of foes that have no mercy; a scuffle then—a crunching of bones—and the Red Monk's life has met its tragic end.

Not one of us guilty ones who hounded brave Monax to his death in many bygone times, can say that he ever turned tail, cried quits, or died except as a hero dies. And yet I hope none of us ever played as low a part as is ascribed to the men who did to death the noble little brute that figures in this tale. The incident is vouched for by Harold M. Anderson, of the N. Y. *Sun*, and was fully reported in the New York *Herald-Tribune*, March 25, 1925.

---

[67] Forest & Stream, June, 10, 1911, p. 899.

[68] As above, June, 1924, p. 360.

At Leominster, Mass., in the Happy Hollow of Main Street, on March 24, 1925, there took place a fight between a bulldog of battling breed and a lone and harmless Woodchuck that somehow had strayed far from his own domain. The battle lasted "more than an hour, and attracted a great crowd in trolley cars and in automobiles, while hundreds on foot looked on.

"The bulldog was badly lacerated, and finally, bleeding and completely exhausted, limped away from the scene of battle." Afterward, "*the Woodchuck was stoned to death* by two bystanders."

Noble bulldog! Noble bystanders! Thrice noble deed! Doubtless, the children of those men will be told the story of their fathers' splendid heroism, for many years to come.

Long Ago and Now

I shall never forget my first acquaintance with the Woodchuck. It was in 1867 in the woods near Lindsay, Ont. Our fighting terrier, 25 pounds, had covered himself with glory by killing—with the help of two men and an axe—a 5-pound Woodchuck. The creature was paraded for all to see. I was 6 at the time; but to this day, I can smell that peculiar animal smell as I think of it, and see the three little white-capped glands that were thrust out of his anus. His fur is better pictured in my mind than any since, and with me yet is the mixed sense of attraction and disgust it conjured up.

In those early days, the Woodchuck was the largest wild animal that entered into the lives of us boys. In the grainfields, still dotted with stumps, he found a homeland very much to his taste. With some great hulk to stand guard over his doorway, its roots for posts to block all ruthless digging foes, its top to furnish a sunning place and observatory, each fat, contented Woodchuck lived—the happy lord of the small domain about his door. At times, though rarely, the long rifle of the grown-ups would end the career of some rack-renting Chuck that wasted, by overtaxing, his little manor; or perhaps the Fox, who prowled early, snapped up the Woodchuck that prowled late. But in spite of all, his race continued—yea, prospered.

As I read again these piled-up facts and hints of fact, I am impressed by this—that the dominating gifts of the Red Monk of the Fields are two: First, his courage. He is shy and modest as a hero, if let alone; he will go far out of his way to avoid a fight. But never once has it been told that a Woodchuck played the coward, shunned the fight, or begged for mercy. Never has he shown the white feather or yellow streak; no, not even though it were a youngling, barely grown, and the foes an army of Dogs and men, Bears or Elephants.

Second, and of larger import—for more often seen, and more often his salvation—is his sturdy common sense. Cautious is he, never brilliant; brave, but never foolhardy, never rattled, never rash; stodgy and chiefly interested in food, but careful of his health, happy in having enough, with safety and a little place in the sun.

References

1842—American Natural History, by John D. Godman, I, pp. 325–31; 1 plate.

1849—Quadrupeds of North America, by Audubon and Bachman, I, pp. 16–24; 1 plate.

1884—Mammals of the Adirondacks, by C. Hart Merriam, pp. 240–52.

1893—Investigations of the Burrows of the American Marmot (*Arctomys monax*), by Wm. Hubbell Fisher, Cincinnati, O. From the Journal of the Cinn. Soc. Nat. Hist., July–Oct. Vol. XVI, pp. 105–23; Pls. VI to X.

1898—The Woodchuck as a Game Animal, by Angus Ballard, *Recreation*, Sept., pp. 200–01.

1902—American Animals, by Witmer Stone and W. E. Cram, pp. 151–59; 2 plates.

1909—Woodchuck Ways, by Raymond S. Spears, *Forest & Stream*, July 21, p. 176.

1915—Revision of the American Marmots, by Arthur H. Howell, N. A. F. 37, U. S. Dept. Agri., Biol. Surv., 80 pp. 15 pls.

LIFE LXXIX—THE ROCKCHUCK

PAGE
Names 338
Description: Size, Weight, Colour 338
Races 339
Range and Haunts 340
Numbers 340
The Ringing Voice 342
Diet 342
His Rocky Fortress 342
Breeding and Young 343
Yellow-robe's Foes 344
Parasites and Disease 344
His Way of Life 345
In Winter Storms 347

References 349

KING OF THE CASTLE

Rockchuck, Yellowfoot, Yellow-footed Marmot, Yellow-bellied Marmot, Yellow Marmot, Yellow Ground-hog, Western Woodchuck, Golden-mantled Whistler, Yellow-robe, Yellow-belly, Yellow Whistler

Marmota flaviventris (Audubon and Bachman)

(L. *Marmota*, see *ante; flavus*, yellow; *ventris*, of the belly)

Arctomys flaviventer Audubon and Bachman, 1841, Proc. Acad. Nat. Sci. Phila., p. 99.

[*Marmota*] *flaviventer* Trouessart, 1904, Catal. Mamm. viv. foss. Suppl., p. 344.

Type Locality—"Mountains between Texas and California," fixed by Howell as Mt. Hood, Ore.

The three Marmots are recognizable at once by these characters:

The *Eastern Woodchuck* is a brown animal in a silver-tipped robe, with blackish feet and face.

The *Rockchuck* or *Yellowfoot* is in a silver-tipped robe, but is a yellowish animal with dark brown head and tail, tawny feet, and a whitish band across the face in front of the eyes. The yellow feet are a strong and constant feature.

The *Hoary Marmot* or *Whistler* is a big, whitish animal with blackish feet, tail, and crown.

In addition to the generic characters, the Yellow Marmot has the following:

Size. Total length, about 28 in. (711 mm.); tail, 7 in. (178 mm.); hind foot, 3½ in. (88 mm.).

Weight. Howell gives the following weights of 4 adult males: 10 lbs., 12 lbs., 8 lbs., and 17 lbs., the last being very fat.[1]

Colour. General colour above, russet, grizzled with white, the fore back with more or less of a yellowish mantle; underparts, dull yellowish or brownish buff; feet, yellow or tawny; tail, brownish gray.

Every one of the Marmots is subject to melanism, the Hoary Marmot excessively so; and among the Yellow Marmots, entirely black specimens are not uncommon. In the mountains north of Vernon, B. C., according to Allan Brooks, they are said to be all black and of large size.[2]

---

[1] Revision, p. 36.

Howell, commenting on this, says: "A dark phase occurs also in *M. flaviventris luteola*, but this can hardly be said to be melanistic. . . . A curious specimen of *M. f. avara* from Pullman, Wash., has the tips of the hairs of the head, foreback, and most of the underparts dark blackish brown, the hinderback being pale grayish mixed with dark brown."[3]

Mammæ in 5 pairs.

RACES

The following races have been recognized:

- *flaviventris* Audubon and Bachman, the typical and largest form. T. l., Mt. Hood, Ore.
- *avara* Bangs, similar, but smaller and paler. T. l., Okanagan, B. C.
- *sierræ* Howell, similar to *flaviventris*, but smaller and redder. T. l., head of Kern River, Mt. Whitney, Calif.
- *engelhardti* Allen, similar to *flaviventris*, but smaller; underparts darker. T. l., Beaver Range Mts., Beaver Co., Utah.
- *nosophora* Howell, the size of *engelhardti*, with longer tail; yellower above, and redder below. T. l., Corvallis, Ravalli Co., Mont.
- *dacota* Merriam, size large, coloured like *nosophora*, but underfur redder, and less mixed with black. T. l., Custer, Black Hills, S. D.
- *parvula* Howell, similar to *avara*, but smaller and darker. T. l., Jefferson, Nye Co., Nev.
- *luteola* Howell, like *dacota*, but underparts yellowish instead of deep red. T. l., Medicine Bow Mts., Wyo.
- *warreni* Howell, like *dacota*, in size but deep red, with little buff. T. l., Crested Butte, Gunnison Co., Colo.
- *obscura* Howell, in size equals *flaviventris;* tail long; colours dark brown mixed with white; face usually without white markings. T. l., Wheeler Peak, Taos Co., N. M.
- *fortirostris* Grinnell, decidedly smaller than *sierræ*, but larger than *parvula;* averaging paler than *sierræ*, especially on lower surface where it is ochraceous; tawny instead of cinnamon-brown. T. l., White Mts., Mono Co., Calif.
- *campioni* Figgins, in size like *obscura*, but notably whiter on head, throat, and underparts. T. l., Higho, Jackson Co., Colo.

---

[2] Yellow-foot, p. 377.

[3] Revision, p. 17.

RANGE AND HAUNTS

The range of the Yellow Marmots is between that of the Brown and the Hoary, in point of elevation; about 6,000 feet above the sea is their ideal level; however, they are found down to 2,000 and up to timberline; not beyond that, except *obscura* which reaches the highest peaks, 13,700 feet.

Speaking of the form *sierræ* in Mono. Co, Calif., A. Brazier Howell says: "Woodchucks are abundant throughout the region wherever there are rock slides; and these occur from 8,000 to 9,500 feet or more."[4]

The favourite haunts of the Yellow Marmot or Rockchuck are piles of tumbled rocks near rich, grassy meadows. But any rocky place with labyrinthine crevices near to good grass is acceptable if within their range. Instances are on record of their harbouring under deserted buildings, much as do our Eastern Woodchucks at times. Unlike the Eastern Woodchuck, however, they are never found far from hills.

Only in southern British Columbia and northern Idaho, do we find all 3 species of Marmot. Their ranges overlap, in a broad sense, but their haunts do not; for the Hoary species keeps to the highest peaks; the *Monax* the lowest valleys (except in the Rocky Mts.); and the present is in the rock piles between. In the Rocky Mts., the *Monax* occurs on the heavily timbered mountain-sides above the range of *flaviventris*, according to Howell.

A. Brazier Howell has a curious note on an unusual haunt of this species in California. "From July 12 to 15, 1917," he says, "I trapped in a Mountain Beaver burrow 6 small young that were barely able to get about. I have also caught adults in such situations, when the burrows were particularly large; and I judge that the Marmots use these when convenient, during their journeys to water. The drier abandoned portions of the burrow systems may also be used to some extent as homes by these animals."[5]

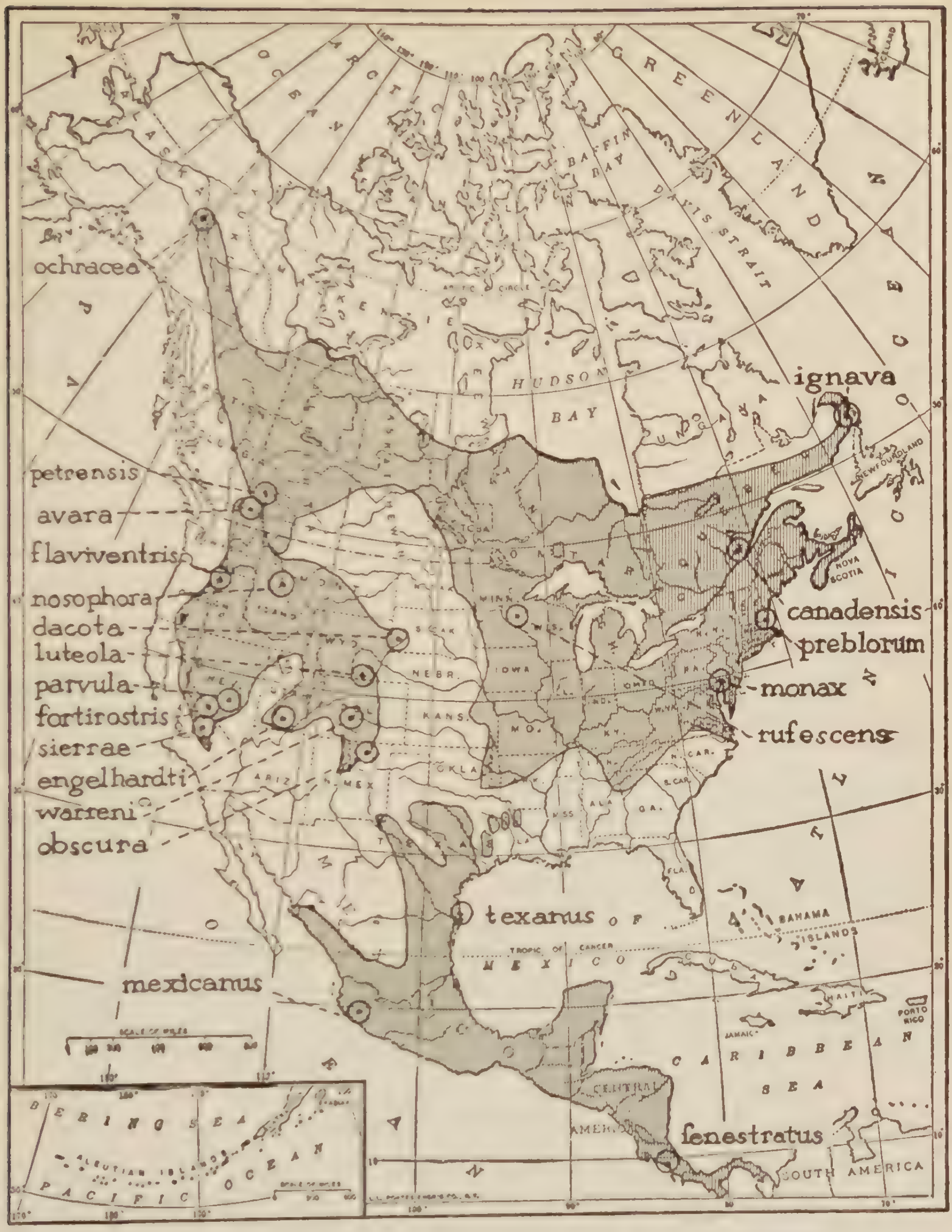
NUMBERS

Because they gather into something like colonies, they seem much more abundant than the Brown Woodchuck. On one 200-yard rock pile back of Yancey's in Yellowstone Park, I am safe to say there were at least 100 Rockchucks. Then again there were square miles of pine woods and upland to be crossed before the next suitable place was found with its teeming whistling colony.

---

[4] Journ. Mamm., Feb., 1924, p. 33.

[5] As above, Feb., 1924, p. 33.



MAP X.—RANGE OF THE WOODCHUCK, OF THE ROCKCHUCK, AND OF THE ARMADILLO

By E. T. Seton, with assistance of the Biological Survey, 1927

C. Birdseye writes of the species in Montana: "In the Bitterroot Valley, they are especially numerous in rock piles, and around abandoned buildings along the valley's edge. From one rock pile in a timothy field, I took 15 Woodchucks in 1910, and as many more in 1911; from under the buildings of an unoccupied ranch, at least a dozen were secured during these two seasons; and in the stone wall surrounding a neglected orchard, I estimated that there were at least 30 adult Woodchucks."[6]

On the great scaur-varied plain of Wyoming, 30 miles northwest of Cheyenne, there was certainly a family of Yellow Whistlers to every craggy rock, and a dozen craggy rocks to the square mile.

The Ringing Voice

Its common note, that is, the alarm note with which it greets all intruders on its domain, is a short, sharp, ringing whistle, much like that of the Hoary Marmot, but not nearly so strong or piercing. Without doubt, it has many other whistles and calls, including a love-song; but they have not yet been described or recorded.

Diet

The food of Yellow-footed Marmots is similar to that of Eastern Woodchucks; but probably includes a larger proportion of wild plants, and less grass and clover. "Vernon Bailey found in the stomachs of the Black Hills Marmot, flowers, leaves, and green seeds of various plants, including *Astragalus bisulcatus* and *Sedum douglasii*. In dry excrement of Marmots at Spokane Bridge, Wash., he found the seeds of *Amelanchier alnifolia* and *Rubus nutkanus*." (Revision, p. 13.)

Birdseye states that the Marmots in the Bitterroot Valley, Mont., feed on "timothy, clover, alfalfa, dandelions, and numerous native plants. . . . In hayfields, they consume a very considerable amount of feed; and beans, carrots, potato vines, cabbage, and other garden truck are almost sure to suffer whenever Woodchucks have access to them."[7]

His Rocky Fortress

The dens of the Yellowfoots that live in the great rock dumps such as that back of Yancey's, are absolutely beyond reach of any ordinary investigator. A Grizzly-bear might open them if he thought it worth while, but I never knew him to do it; the labour is too vast for the returns. The Weasel doubtless examines them at times, but he does not make a report; so that we are pretty nearly without information.

---

[6] Mamm. West. Mont., p. 27,

[7] As above, p. 28,

The actual nest of the Rockchuck is in some snug cave or in the end of a crack that can be plugged and lined. One that I saw in the crags northwest of Cheyenne was 10 feet down a crevice that was a foot wide. It was of sticks, evidently carried up there by the owner. I could not get near enough to examine it. Another, the one I sketched, was in a cranny 15 feet up the cliff; it also was of sticks and roots, and beyond reach. (Plate XXXVII, p. 346.)

The few observations I could make, and the light of analogy, show that the castle is the abode of one family. As soon as the young are big enough, they leave home to seek some citadel for themselves.

BREEDING AND YOUNG

"The Yellow-footed Marmots," says Howell,[8] "breed at about the same season as their Eastern relatives, and produce from 3 to 8 young at a birth. In the Bitterroot Valley, Montana, 5 females collected between April 8th and April 16th, were pregnant, the number of embryos being in most cases 5 or 6 (in one case 3)." Warren states that "a female taken at Sulphur Springs, Grand Co., May 4th, contained 4 embryos."[9]

Young Marmots were big enough on May 30th in the Bitterroot Valley to be outdoors.[10]

On June 11, 1921, while climbing 13,000 feet A. S., on the southwest slope of Mt. Ross, Park Co., Colo., Fred W. Miller of the Museum, Denver, tells me that he saw a mother Marmot moving her young from a den far above timberline to another a quarter of a mile down hill, over ragged rocks and more than one cliff that was nearly a straight drop. The young, 4 in number, were less than a week old, as their eyes were barely open. They were carried one at a time, held by the scruff of the neck; they hung down limp like a kitten. One which the mother dropped in her haste, uttered a loud, shrill squealing, and kept it up for about 40 minutes, till mother came back and carried him off.

On June 14th, in Yellowstone Park, I found them half-grown, and running far from home and mother. One which I easily captured to sketch, was the tamest wild thing I ever handled—perfectly happy to sit in my arms and let me scratch its head. As Allan Brooks says, they "are ridiculously easy to catch, rushing into any crack or hole in the rocks, even if not big enough to cover them entirely"; and here with only head hidden, they readily submit to being taken and handled.[11]

---

[8] Revision, p. 12.

[9] Mamm. Colo., p. 148.

[10] Revision, p. 12.

Yellow-robe's Foes

It is commonly said that the Grizzly-bear is a dangerous enemy to the Yellow Rockchucks, as well as to the Hoary Marmots; but I never saw any signs of his digging out the former. I should much like to be present when the Grizzly undertook the job, for I cannot imagine anything less than a big charge of dynamite opening up any of the Rockchuck dens that I have seen.

I do not know of any animal that the Yellow-robe need fear when in his rocky fortress. When abroad, of course, there are plenty who eat him, and no doubt many an innocent June youngster is picked up by Coyotes, Wolves, and Lynxes.

A much more dangerous enemy is the eagle. Allan Brooks says: "In the summer, Marmots form $\frac{9}{10}$ of the food of the golden eagle.

"Many Indians have told me that when an eagle catches an unusually large Marmot, it ascends with it to a considerable elevation, and drops it to the rocks below, repeating the performance if the animal is not dead after the first fall. I have never seen this done, though I have many times seen an eagle drop on a luckless Marmot from a great height, rushing downwards with closed wings, almost perpendicularly."[12]

Parasites and Disease

But darker, deadlier possibilities of destruction are foreshadowed in a recent pamphlet issued by the U. S. Biological Survey.

It has long been known that the spotted fever of the Rocky Mountain region is peculiarly virulent in Bitterroot Valley, Mont. A certain tick, *Dermacentor venustus*, was believed to be the travelling agent of this dreaded scourge—the chief, if not the only host and disseminator of the disease. To complete the chain, it was necessary to determine which wild animal was the principal host of the tick. While many wild creatures are the innocent victims of the fever tick, it seems that Squirrels, Chipmunks and Woodchucks are the hosts chiefly responsible for harbouring it while in its nymph and seed stages. In its adult or blood-sucking stages, it is found on the big game and domestic stock. The Yellow Marmot seems to be the only creature that carries the tick in all stages.

---

[11] Yellow-foot, p. 377.

[12] As above.

"About 25 of these animals," says Birdseye, "were examined for ticks, and it was found that they commonly serve as hosts for nymphs and seeds of *Dermacentor venustus*. On one were found 2 adults of this species; and adults were found to attach and engorge on Woodchucks in captivity."[13]

To this, Howell adds: "The golden-mantled Marmot . . . is known to assist in spreading the deadly spotted fever by serving as host of the fever tick (*Dermacentor venustus*), both in adult and nymphal stages. Over 200 ticks have been taken from a single wild Marmot; and, when in captivity, the species has been shown to be susceptible to spotted fever.[14] Since this Marmot is not utilized for fur, there is relatively little danger of the spread of the disease to other regions through the medium of the animals; but every effort should be made to exterminate them where they occur about cultivated lands or in the vicinity of dwellings. Suggestions for destroying Marmots are given in Farmers' Bulletin, 484, U. S. Dept. Agri."[15]

His Way of Life

It would be hard to imagine a lovelier homeland than the Pole Mountain country between Cheyenne and Laramie. Picture a thousand English parks interspersed with a thousand little piney woods, and ten thousand rugged Yorkshire crags or scaurs that cap, like castles, the rolling grassy slopes above the sedgy lakes, the wimpling brooks, and sweet inviting woods of quaking asp.

These open lawns at one time swarmed with Deer and Elk—alas! all gone!—but are enlivened still by countless Ground-squirrels, Gophers, Mice, Cottontails, and Jackrabbits, with their overlords, rack-renters, and parasites, the Badger, the Fox, the Weasel, and the Coyote.

The rocky hillsides abound with chirping Chipmunks and two-barred Rock-squirrels; but the wonderful feature of the region is always the great castellated granite rocks that cap the swarded hills at their sheerest sides, to dominate the scene, and furnish eyries for the sparrowhawk, the rock-wren, the Rock-squirrel; and, above all, to be the lookout of the Yellow-robed Rockchuck, the Watcher of the Plains.

These rock castles cap every uprise—there is one at least for each half mile. They are of the hugest granite blocks, piled up by earth convulsion, sculptured by ice and weather erosion, split and cleft in a hundred general lines that give them a builded look, and furnish unnumbered lurking places for the Whistlers, a family of which inhabits each tall citadel.

---

[13] Mamm. Bitterroot Vall., p. 15.

[14] Mamm. West. Mont., p. 28.

[15] Revision, p. 15.

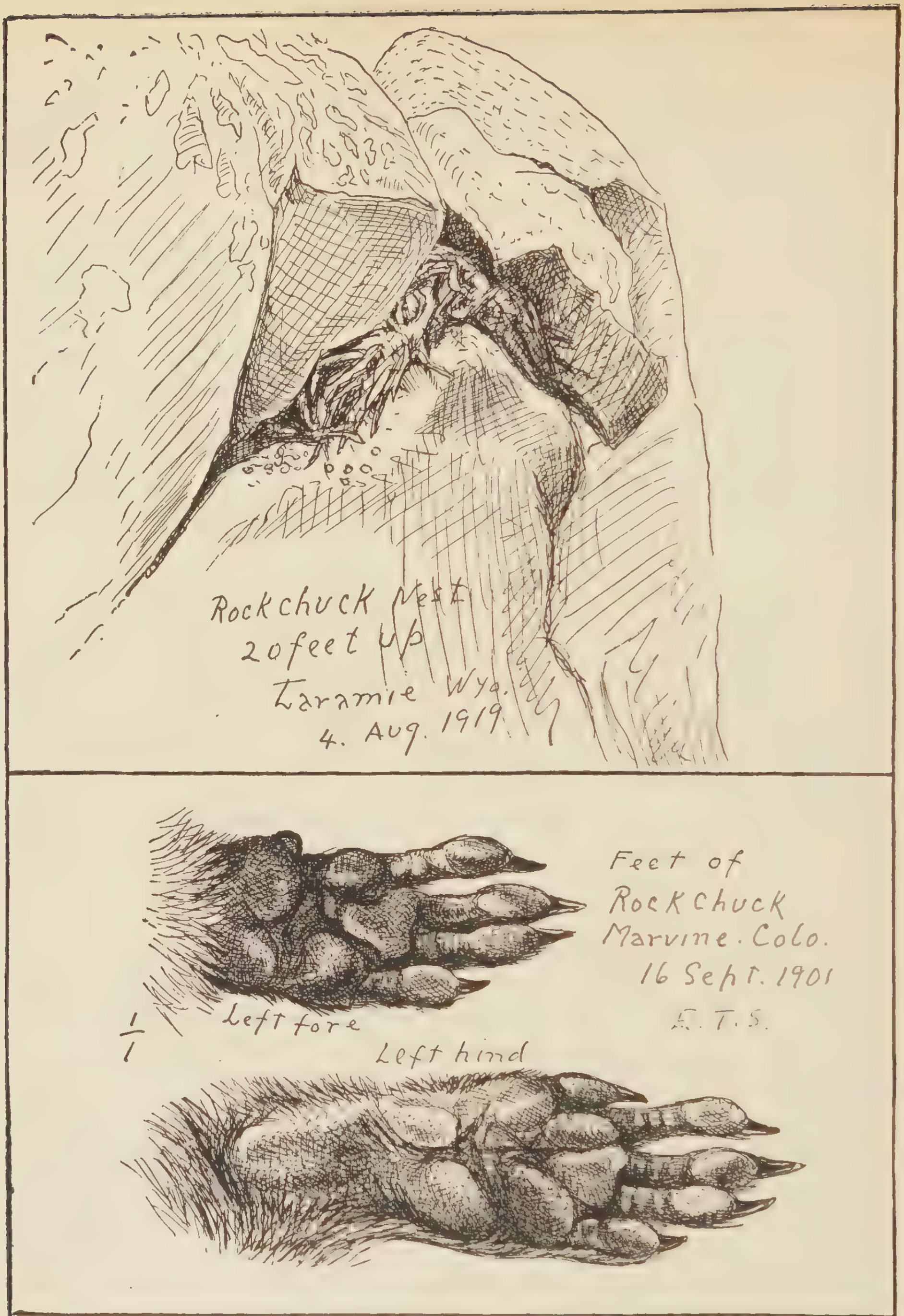


Plate XXXVII. Details of Rockchuck. E.T.S.

High on some sunny crag that gives full fifty miles of view, the Rockchucks lie in the morning. There is nothing in their colour or habits that suggests concealment. You can see the gleaming golden mantles half a mile away. But their eyes are as sharp as yours. Many sad experiences have taught their tribe that a man on foot is a man with a far-killer—a thing of thunder and death—and instantly the sprawling watchers are alert. A shrill, short whistle each sends forth, and every Marmot on this rock and every rock for half a mile, is keen agog, or rushes coverward to some safe hiding place.

Most of the summits are unscalable to man; but the Rockchuck has searched out every crevice, and usually has some secret climbway or narrow crack up which he can scramble to the very best and safest lookout.

For generations, these have been in use, as is proven by the vast accumulations of sign lodged in every cranny, and piled below the sloping sides. But the function of the watchers must have changed since the white man came—since the Buffalo, Elk, Deer, and Antelope gave place to the "spotted Buffalo" of the range.

In those halcyon days, the redman with his bow took little count of the Whistler. Why should he, when the easier shot and bigger game brought ten times the hunter's spoils?

Yet the Rockchuck had his enemies. When he sallied forth to the rich feeding grounds about his castle, the Wolf, the Coyote, and the Bear were ready to nab him; and the eagle was at all times a menace, even when the Chuck was in seeming safety on his highest turret perch. For these it was that the watchman learned to use the welkin-reaching whistle—and thus resolved the riddle of his life.

There never yet was a big success without a train of feeble imitations—a great chief without a horde of satellites, glad to shelter behind his power. Many small creatures court the protection of the Whistler and his castle.

First among them, perhaps, is the two-barred Rockchip—the funniest, fattest little pot-bellied elfin that ever played brownie among the high constructed rocks of the Whistling Watchman's home. This comical Rock-squirrel settles down to eat the crumbs from the great one's table; and the keen-eyed watcher on the cliff announces without fail the eagle or the Fox, as well as the human hunters and all the other enemies of the Rock-squirrel—for are they not also his?

In Winter Storms

Only in warm, sunny times is the Whistler marked at his noisy best and up aloft. On chill days and wet days, we see him not at all. At the end of the season, when all the days are chill and wet, he accepts the inevitable—he bows his head to the storm, and falls back on the ancient way of his family, by declining for months to stir abroad when the weather is not to his liking. And since he belongs farthest south of his group, he is least tolerant of the cold. He goes down earlier, and stays longer, than do the others. Seven months of each year he seems to give to subsoil meditation.

"The Yellow-footed Marmots," says Howell, "go into hibernation between the middle of August and the first of October, the date varying with the altitude and local conditions. Individuals living in the valleys retire earlier than those living higher up in the mountains. Warren states that in Gunnison Co., Colo., this species dens up about the first of October, but individuals are sometimes seen much later.[16] Allan Brooks states (in epistle) that at Okonagan Landing, B. C., practically all these Marmots disappear before the middle of August, but he has occasionally seen their tracks as late as early October. [No doubt, weather variations were the cause of the date variants.] In the mountains of Montana and Wyoming, this species usually enters hibernation during the last of August or the first of September; Biological Survey field parties have never found the animals later than the first week in September."[17]

S. E. Osborn gives the following account of the Yellow-footed Marmot found in midwinter in the Silver Mountain Tunnel, at Ophir, Colo. His observations show that, in its winter sleep, the species is much like the Eastern Woodchuck.[18]

"[He] had packed in grass for a nest, and taken up his winter quarters. He was rolled up like a ball, with his fore paws over his eyes. We pulled his paws away, and his eyes were closed. All our efforts to awake him were futile; he would yawn like a boy that had been disturbed when sleeping soundly, return his paws to his eyes, and curl himself up in his original position."

Thus, the deadly time of blizzards, Arctic frost, and starvation is safely passed; and when the winds are softened, and the snow blanket washed into brown spots on the hillsides, the Golden-mantled Whistler far down in the bosom of Mother Earth responds to some strange vernal influence, deeper and stronger than wind and weather, and in upland valleys like the Bitterroot, comes forth, with early March.

"The first one seen [there] in the spring of 1910," says Howell, "was on March 24th; and by April 1st, they were numerous. In 1911, one was seen by Bernard Bailey on March 13th." In western Oregon, which is much lower and milder, it was seen as early as Feb. 4th (Klamath Lake), and as late as Sept 25th (Mount Hood.)[19]

---

[16] Mamm. Colo., p. 148.

[17] Revision, p. 11.

[18] The Observer, III, 1892, p. 32, quoted in Revision, p. 12.

By April they are numerous in their main range. Once more, their yellow mantles and loud signal chirps enliven the rock piles; and they proceed to live the summer life all over again, with its feasting, its love-making, its alarms.

REFERENCES

1898—The Yellow-footed Marmot, *Arctomys flaviventris*, by Allan Brooks, *Recreation*, Nov., p. 377.

1910—The Mammals of Colorado, by Edward R. Warren, pp. 145–48; 2 ills.

1911—The Mammals of the Bitterroot Valley of Montana, in Their Relation to Spotted Fever, by Henry W. Henshaw and Clarence Birdseye. Biol. Surv. U. S. Dept. Agri. Circular No. 82, Aug. 3, 1911.

1912—Some Common Mammals of Western Montana in Relation to Agriculture and Spotted Fever, by Clarence Birdseye, Farmers' Bulletin 484, U. S. Dept. of Agriculture.

1915—Revision of the North American Marmots, by Arthur H. Howell, N. A. Fauna No. 37.

---

[19] Revision, p. 11.

LIFE LXXX THE HOARY MARMOT

PAGE
Names 352
Description: Size, Weight, Colour 352
Races 353
Robe and Flesh 353
Range and Haunts 354
Numbers 354
Seeking His Food 355
Safe in the Rocks 356
The Voice of the Whistler 357
Family Ties 357
His Way of Life 359
His Grizzly Foe 360
The Medicine in the Sky 361
The Bolt from the Blue 361
His Winter Death 363

References 364

Hoary Marmot, Mountain Whistler, White Whistler, Gray Whistler, Whistler of the Rocks, Whistler of the Peaks, Whistling Badger, Gray Marmot, Mountain Marmot, Mountain Badger, Siffleur, Whistling Pig, Whistling Marmot, Gray Groundhog

Marmota caligata (Eschscholtz)

(L. *Marmota*, see *ante; caligata*, booted)

Arctomys caligatus Eschscholtz, 1829, Zool. Atlas, Pt. 2, p. 1, pl. 6.
Marmotta caligata Allen, 1903, Oct. 10, Bull. Am. Mus. Nat. Hist., Vol. 19, p. 539.

Type Locality—Near Bristol Bay, Alaska

French Canadian, *le Siffleur*.
Cree, *Quis-qui-su* (Harmon).

This finest of all our Marmots, is, next after the Beaver and the Porcupine, the biggest rodent in North America. When seen afar, it looks like a big white or gray Badger with dark face, feet, and tail.

In addition to the generic characters, it has the following:

Mammæ in 5 pairs usually, whereas in the *monax* group there but are 4, as a rule.

Size. Total length, 28 to 29 in. (710 to 735 mm.); tail 8¼ to 8⅝ in. (210 to 218 mm.); hind foot, 3⅝ to 4⅛ in. (91 to 105 mm.). Females 5 per cent. smaller.

Weight. From 20 to 25 lbs., according to W. H. Wright[1]; that is, twice as big as a Woodchuck, and as big as an average Badger. Howell, however, gives the following as actual weights: adult ♂, 11 lbs., 15¾ lbs.; adult ♀, 9 lbs., 11½ lbs., 17 lbs.[2]

Colour. General colour above, clear silver-white, peppered over with black tips to the hairs, becoming cinnamon-buff splashed with black on the hind back, rump, and tail; top of head and face, black with a white patch in front of eyes; feet, blackish brown, like boots whence the *caligata;* underparts, soiled whitish.

---

[1] Grizzly Bear, p. 80.

[2] Revision, p. 56.

The midsummer coat is more or less yellowish brown; the winter coat, which is resumed in the early fall, is light gray, and even whitish in places, as above.

"Melanism," says Howell, "is most strongly developed in the subspecies *Marmota caligata vigilis*, occupying the region around Glacier Bay, Alaska. In this race, some individuals are entirely black except for a few grayish hairs on the sides and neck, and small whitish patches on the underparts and noses."[3]

Races

The following races have been recognized:

caligata Eschscholtz, the typical form. T. l., near Bristol Bay, Alaska.

vigilis Heller, like *caligata*, but darker, top of head and hind feet always brown. T. l., west shore of Glacier Bay, Alaska.

sheldoni Howell, like *caligata*, but smaller. T. l., Montague Id., Alaska.

oxytona Hollister, colours much blacker, and tail darker than in *caligata*. T. l., head of Moose Pass Branch, Smoky River, Alta.

okanagana King, in colour like *oxytona*, but whiter; skull like *caligata*. T. l., Gold Range, B. C.

nivaria Howell, the whitest of all; in size and skull like *oxytona*. T. l., Upper St. Mary's Lake, Teton Co., Mont.

cascadensis Howell, very large; larger than *caligata*, but like it in colour. T. l., Mt. Rainier, Wash.

olympus Merriam, as large as *cascadensis*, but darker; general colour, brownish drab. T. l., head of Soleduc River, Olympic Mts., Wash.

vancouverensis Swarth, size of last, but general colour uniform dark brown. T. l., Mt. Douglas, Vancouver Id.

Robe and Flesh

The pelts of the Hoary Marmot are gathered regularly by the Indians of western Canada and Alaska. If taken in the fall when prime, softly tanned, and a dozen sewn together, they make a fine robe. Daniel W. Harmon wrote long ago: "The skins of these animals are very useful to the natives for clothing. They dress them, with the hair on; and sew a sufficient number of them together, to make a garment, as large as a blanket, which they wrap around their bodies."[4]

---

[3] Revision, p. 17.

At Kotzebue Sound, in Alaska, Nelson says that he saw a great many Hoary Marmot "skins made up into clothing, and worn by the Eskimo from the headwaters of the Kowak and Nunatog rivers."[5]

With a dozen pounds of delicious, good, grassified meat on its bones, the Whistler is reckoned game, and one fat specimen is enough to feed a whole family for a full meal. But the wise old Graycoats go not far from their dens; they are hard to shoot, so the Indians take them in traps set at the mouths of their holes.

Range and Haunts

The range of the Hoary Marmot is throughout the Canadian and Hudsonian regions of the Rockies, from latitude 45° to 76°; practically to the Arctic Circle.

Reference to Map IX (p. 279) shows that there is no overlapping of the three species of Marmot. In the one or two areas where they seem to occupy the same range, it will be found that this one is high up near the timberline, and its cousins low down in the valleys; so that, though they are found in exactly the same region, they are not in the same locality.

The Whistler is abundant on all the mountains in Glacier Park—is, indeed, the only species of Marmot found there. The Kootenai country and the shank of Idaho alone can claim all three species within their limits.

In the southern part of its range, the Hoary Marmot lives up near timberline, on or about the ever-friendly and protecting rock pile; but in northern British Columbia and in Alaska, where the Canadian and Hudsonian faunas cover all the land below timberline, it often makes its burrows in grassy flats or on open hillsides.

Numbers

It is not easy to form an exact idea of this Marmot's numbers. Evidently, it is very abundant in northern British Columbia, Yukon, and southern Alaska. Sheldon's narrative contains frequent mention of the numerous Marmot on the Upper Yukon. Hollister says they are "common above timberline over most of the Robson region. On a rocky meadow above our camp on the east fork of the Moose River, Kinney and Kain reported the animals as very abundant in large colonies. Kain told me that he saw fully 100 Marmots in the day's climb, July 22d. Mr. [Arthur O.] Wheeler reported Marmots common, high up on Yellowhead Mountain, Sept. 1st. Mr. Kinney told me that they were abundant on Robson, and we found them present whenever we climbed above timber on any of the mountains."[6] Mt. Robson is about long. 119° 10″ W., lat. 53° 10″ N.

---

[4] Journal, p. 378.

[5] Nat. Hist. Alaska, 1887, p. 282.

The abundance of the species in this region is a fair index to its numbers in all the central part of its extended range. It is indeed a happy thought that, in the vast region between the Columbia and the Yukon, this splendid, picturesque wild thing still continues to be found in millions, and is likely to do so into the indefinite future; for, amid all these swarms, the naturalists, after nearly three months, with a dozen guns and unlimited ammunition, secured but 3 specimens, and only one of them an adult male.

Seeking His Food

Grass, herbage, flowering plants, berries, and roots seem to be the staple foods of the Hoary Marmot; that is, it has the same tastes as the Woodchuck of the East, and modifies them only to meet the opportunities of its homeland. Those who have been privileged to see the glorious profusion of flowering plants and berries in all the upland pastures of the Whistler's range, will realize that it lives in a land of plenty; and if it be not fat when summer wanes, it must have been sick or lazy.

Bailey, after spending a season with them in Glacier Park, wrote: "Their food consists mainly of green vegetation, and they are often seen grazing in the meadows, picking the various little plants, and eating them—stems, leaves, flowers, seeds, and all. I have not been able to determine the species eaten, but their large stomachs usually contain a well-masticated mass of green herbage with traces of flowers, seeds and stems. One old fellow in Kootenai Pass, when suddenly alarmed while feeding, rushed to the top of a big boulder, with his mouth still full of green leaves which he slowly chewed while watching me.

"Along the trails over the high passes, Marmots gather to pick up the scattered oats left by the Horses; and are often so eager for this unusual feast that they would let me take snapshots at 15 or 20 feet before they would leave the trails. The constant passing of tourists, pack trains, and saddle Horses is teaching them confidence in these strange new denizens of the park; and evidently, with a little care and feeding, they could be coaxed into tameness."[7]

---

[6] Can. Alpine Journal, 1912, p. 28.

[7] Glacier Park, p. 52.

Richardson says it "may be frequently seen cutting hay in the autumn; but whether for the purpose of laying it up for food, or merely for lining its burrows, I did not learn."[8]

As animals which hibernate get exceedingly fat, and therefore do not need to lay up a store of food, we must assume that the hay thus carried in, is for bedding. This, however, would not prevent them from eating it if a time of pinch should come.

Safe in the Rocks

So far as I have seen, the burrows of the Whistler are exactly like those of the Yellow-footed Marmot—sometimes on an open hillside, by or under a flat rock or a great boulder, but invariably arranged so as to have the protection of massive rocks about the portal to the den. In regions where the Grizzly-bear abounds, the den is always among a heap of tumbled rocks, of a size and weight that have kept the creature's home life a secret from all naturalists; and, in most cases, offers an effectual obstacle to the entry of even a hungry Bear.

On the mountain-sides of Alaska, Osgood found the Hoary Marmots "living in grassy meadows above timberline, and on open hillsides rather than on rocky places. Their burrows in these places differ from those of Spermophiles [Ground-squirrels] only in size. Wide, well-beaten paths through the grass connect different burrows, and diverge from them here and there over the slopes in the same manner as those of the Spermophiles [Ground-squirrels]. The vicinity of the burrow is usually very filthy with excreta";[9] which last probably means that the den itself is kept absolutely clean.

According to J. K. Lord, the burrow is "dug invariably in a slanting direction, generally at the base of a rock, standing up like a pedestal, and on which they love to sit and whistle. Wide trails and bear-like roads, lead in all directions from their holes, to the feeding and drinking places."[10]

The only den exposed and on record, was opened by a Grizzly-bear, and described by W. H. Wright as follows: "The [Marmot] den ran in under several layers of loose flat rocks, some of which were 2 or 3 feet long by half as many wide, and several inches thick. . . .

"These animals had burrowed down some 6 or 7 feet into the side of the mountain; and under a large flat stone, they had scooped out a little cave some 3 feet in diameter, where they had a soft bed of grasses that they had carried in."[11]

---

[8] F. B. A., I, p. 150.

[9] Cook Inlet, p. 63.

[10] Naturalist, II, p. 194.

THE VOICE OF THE WHISTLER

All the popular names of the Hoary Marmot connote its wonderful voice. Harmon, the old fur-trader, who first described the creature from the land side, said: "There is a small animal, found only on the Rocky Mountain, denominated by the natives *Quis-qui-su*, or *Whistler*, from the noise which they frequently make, and always when surprised, strongly resembling the noise made by a person in whistling."[12]

Richardson, after describing the foraging of the species, adds: "While a party of them are thus occupied, they have a sentinel on the lookout upon an eminence, who gives the alarm on the approach of an enemy, by a shrill whistle, which may be heard at a great distance. The signal of alarm is repeated from one to another as far as their habitations extend."[13]

There can be little doubt that it is the shrillest, farthest-reaching sound in animated nature, within the territory covered by this book. It is easily heard a mile distant, and, under favourable circumstances, maybe twice as far. This is the alarm note.

Hollister writes: "When badly frightened, they utter short, sharp whistles in such quick succession that one would have some trouble to count them." And adds: "They also utter a low-sounding whistle that one could scarcely believe came from the same animal."[14] Maybe this last is the "all clear" signal.

Undoubtedly, it has in addition many other sounds—cooing notes and war cries. Furthermore, it is a moral certainty that an animal with so many musical calls has a love-song; but, so far, it has not been recorded.

FAMILY TIES

The analogy of the Eastern Woodchuck would show that the species pairs, and that the mating takes place in the very early spring, as soon as the Marmots awaken from the winter sleep. But there are few observations on record to settle these many points.

In the Bitterroot Mountains of Idaho, in late Sept., 1902, I found a pair of Hoary Marmots associated on the same rock, and therefore, probably paired, as no others were about.

---

[11] Grizzly Bear, p. 82.

[12] Journal, p. 377.

[13] F. B. A., I, p. 150.

[14] Can. Alpine Journal, 1919, p. 54.

Because in their boreal home the spring is late, the Hoary Marmots breed somewhat later than their smaller relatives in the South and East.

According to Harmon,[15] "they generally produce 2 young at a time; and set upon the hind feet when they give them suck." Which probably means that he saw them doing it that way once, when they were big enough to be out and in view. It is morally certain that the young are suckled just as are the young of Rabbits and Squirrels.

In Glacier Park, "the young are born apparently about the first of June, as a female collected May 27, 1895, contained 5 well-grown embryos. . . . On August 1, 1917, in Gunsight Pass, a family of 4 young, about the size of Ground-squirrels, were photographed among the rocks by the side of the trail. . . . On August 4th, 2 young about quarter-grown, were seen in Piegan Pass; and in Kootenai Pass, on August 22d, several small young were seen among the rocks."[16]

In southern Alaska, Swarth found the young running about in the middle of June. On Vancouver Island, however, he says of the Marmots there: "At the time we were in the region, the first three weeks in July, no young ones had yet emerged from the burrows, but several of the females secured were nursing."[17] This implies that these Vancouver mountains are high and have much snow, as the young in lower regions are seen running about much earlier in the summer.

J. Alden Loring observed several young ones quarter-grown about July 1st, in the Henry House region of British Columbia. He took a well-grown female July 7th. In many places, even at this time, the entrances to their holes were in snowdrifts.[18]

In every case, when the half-grown young were observed, the mother was near, loudly whistling her alarm from the rocks overhead, and showing true motherly solicitude for her brood. But nothing was seen of the father.

Whether the younglings are nursed by the mother up to the time of the winter sleep, or whether they fatten themselves on mountain forage, is not known; but sure it is that fat they must be when they turn in, or they will never turn out again next spring.

J. K. Lord says: "Unlike some of the Prairie Marmots, these Rock-whistlers, when married, have a house of their own; and if blessed with a

---

[15] Journal, p. 377.

[16] Glacier Pk., p. 52.

[17] Birds & Mamms. Vanc. Id., Univ. Calif., 1912, p. 90.

[18] Preble, N. A. F., 27, 1908, p. 161.

PLATE XXXVIII.—ROCKCHUCK CASTLES

PLATE XXXIX.—THE TRIBAL WATCHMAN

(*Hoary Marmot*)

family—a blessing seldom denied them—they kick out the youthful pledges of affection as soon as they can nibble up a living for themselves."[19]

All the evidence of other naturalists seems to show that they snuggle in with their mother for the winter; spending thus one whole year in the old homestead, before responding to the complex and dominating essential urge that sets them forth to seek a mate, and make a nest for themselves.

The young are apparently two years in reaching full growth; for in late May, Bailey collected several specimens of half-grown young, evidently born the previous year.[20] Thus, they do not breed till 2 years old. In this, they are unlike our Common Woodchuck.

His Way of Life

Late in the spring, the Whistler comes forth from his half-year sleep. This is probably at the end of April; for on May 13th, on Montague Island, Alaska, Sheldon wrote: "I noticed many Marmots about, some sitting up, some running about the snow near the mountain-tops."[21]

Eminently sociable is he. His people congregate in villages along some acceptable mountain-side whence timber is excluded by the altitude, and there are tumbled rocks with rich annual grasses all about.

High now on some big, outstanding rock, we see the sentinel of the village, though his first claim to notice was the long, shrill alarm whistle that he uttered when he saw us slowly moving up his valley a mile or two away. At that distance, it can be heard by even our dull ears, and farther by the wild things. He gave it at the first glimpse of danger, and every one of the many white-robed Marmots near, ceased filling his fat, round belly with the fresh, green mountain forage. They rush up from low, lush meadows, or scramble down from patches of hillside huckleberry, and scurry—the young ones into holes, the old ones up to their lookout; for each pair has a lookout near its home. Some of them carry a mouthful of grass with them, and continue to chew and stuff themselves, as they gaze about for the cause of alarm.

For a while, they sit and search the offing for the foe. Each one, on seeing the stranger, gives the shrill whistle. It is passed on from mouth to mouth for several miles. All are alert. It is impossible for a hunter to approach a Whistler colony successfully, once the old watchman has blown the danger call.

Other wild creatures, too, take warning from this far-reaching note. Bears, Sheep, Goats, and Deer are quick to heed its alarm, and help the general vigilance. Are not their enemies the same as those of the tireless watcher of the rocks?

---

[19] Naturalist, II, p. 194.

[20] Glacier Pk., p. 52.

[21] Nor. Pac. Ids., p. 97.

If, however, they see no foe, no eagle on the wind, nor Wolf nor Bear near by, and if the old Hoary watchman whistles no longer, they settle down again to eat; that is, the youngsters do. The old ones are not so easily reassured. That old white fellow on the high pinnacle, has wonderfully keen eyes. The mounted hunters have disappeared, but he will watch every possible place where they might again come in view. He will watch till he *knows* that danger is over; and many other old ones are there with their sharp eyes to help the lookout.

Whether they have another—an "all clear" call—I cannot say; but this I know: I had to wait in hiding an hour or more after the alarm call before the "peace footing" was restored. Then the young first, the old ones last, resumed their occupation of feeding on the grasses, or carrying in bundles of soft bedding for the couch of their winter sleep.

There is one habit of the Whistler that exposes him to danger more often than any other. In some way—by smell or colour or hearsay—a long way from his fortress den he has found a grassy patch of especial lure, and thither, at food times, he wends his way—yea, though it be across wide open flats, hillsides, or fields of snow. Far from his safe retreat he goes, and keeps the exact same trail till a path is worn.

Bailey says of those in Glacier Park: "They are occasionally seen crossing the great snowfields or the glaciers, from one point of rocks to another; and on the pass at the head of Kintla Lake, one old fellow had a well-worn trail from his fortress on the rock cliff across a wide, bare slope to the only patch of green willow-carpeted turf within reach."[22]

HIS GRIZZLY FOE

The biggest enemy of the Whistler—the only one that can storm the rocky citadel and take it by assault—is the grim, great Grizzly-bear.

William H. Wright, in his admirable book on that animal, gives an account of such an affair, as he read it in the old wild writing of marks, footprints, and spots of blood. He had seen many Marmots' holes opened by Grizzlies which digged out cartloads of rock and earth, leaving sometimes a cavern 8 to 10 feet deep, and 12 or 15 feet long; but with what result, he could not be sure. However, he came at last to one, the history of which was plainly written in the signs that the old hunter knew. It was in the Selkirk Mountains of British Columbia, some thirty years ago. He was following the trail of an old Grizzly who was foraging, and living the life of a Mountain Bear. Half a mile ahead, the hunter saw on the snowy hillside a great pile of fresh earth, and knew that the Bear had been digging to get at a family of Marmots in their den. Wright continues:

---

[22] Glacier Pk., p. 51.

"The hole he had dug was larger than miners are annually required to excavate in order to hold a mining claim. The den ran in under several layers of loose, flat rocks, some of which were 2 or 3 feet long by half as many wide, and several inches thick. These he had ripped out easily and thrown down hill; and the dirt and small boulders had been hurled out, and now covered the snow all about for a space of 10 or 12 feet.

"On the rocks and snow were large spots and blotches of blood, telling of the feast that had rewarded his labours; and that there had been more than one Marmot was shown by the numerous tracks. . . .

"When the Grizzly broke his way into their home, there had been a great rush for freedom. And as the sides of the hole dug by the Bear were rather steep, the Marmots, in trying to escape, were at a disadvantage. The whole story was plainly written in the soft earth and the snow. Large impressions in the sides and bottom of the hole showed where the Bear had struck at the flying Marmots. One of these latter had evidently succeeded in making the outside; but the tracks of the Bear showed where he had followed in hot pursuit; and a smear of blood on the snow marked the end of the little fellow's dash for life. After killing and eating this one, the Bear had returned to the Marmot den, and devoured the remaining Marmots already killed."[23]

The Medicine in the Sky

Marmots are good climbers. Why not, when their little brown brothers in the East climb trees? But these Marmots exercise their talents of this kind only in climbing some high, rocky pinnacle.

The Gray one loves a sunbath—all natural philosophers do; he loves the sense of security that comes from being on a high place—a common impulse in the wise. So he combines and gratifies these two strong instinctive cravings by climbing to some promontory inaccessible to Wolf or Bear; and there lies sprawling by the hour, exposing to the vibrant, searching, life-injecting sunray, his underparts, his armpits, and his groin—just as our sanest doctors bid us do.

The Bolt from the Blue

The high sunbath seems a safe-place engrossment, for his ears are ever alert for the alarm whistle of the tribal watchman. But, alas, there is one danger that it will not save him from; that is, the golden eagle.

---

[23] Grizzly Bear, pp. 82–83.

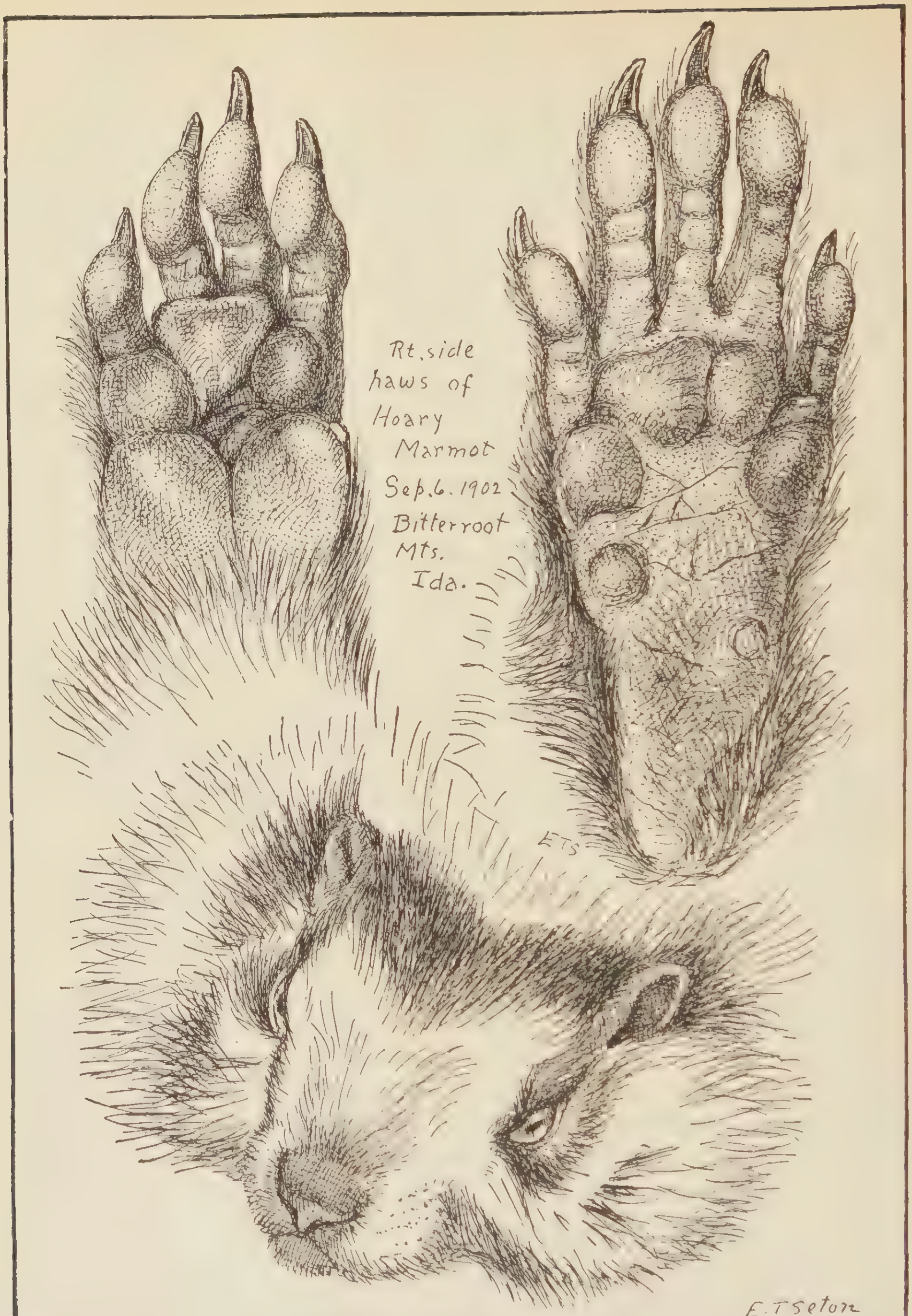


Plate XL. — Details of Hoary Marmot

Flashing out of space—whirling out of nowhere—with the speed of the storm-wind, the Warbird is on him almost before the Watchman shrills his whistled shriek. The very height and inaccessibility of the sunbath rock is his undoing. Yea, even if he fling himself in one long, perilous leap from the top, it is all too slow. Right in midair the Warbird grabs him. True to his lifelong training, and his kinsfolks' weal, he shrills a last, a warning scream. But the death clutch cuts it short—and the eagle feasts.

His Winter Death

As soon as the summer weather goes, the Whistler prepares him for his annual death.

In Alaska, at Valdez Narrows, he turns in about the middle of September.[24] In British Columbia, near Tatletuey Lake, which is 600 or more miles south of Valdez, the species was active above timberline up to Sept. 25th; but then disappeared.[25] By mid-October, at Henry House, the last one had gone for the season.[26] In Glacier Park, when, on Aug. 24th, Bailey crossed Swiftcurrent Pass, the Marmots' loud whistles could still be heard across the rocky slopes. Then, with frost and snow, the first storm came; and down they went for good.[27] When I prowled on these same ranges in late September and early October, I saw some bad weather—frost and snow—but not a single Whistler did I see.

If, in the years, there seems something like regularity in the date of departure, it is probably due to the regularity of the autumn storms.

Hibernation, the deep, deathlike cold-sleep that possesses many animals during the time of intense frost, is a phenomenon not yet fully understood. Some Northern species, as the Ground-squirrels, spend 6 or 7 months underground, presumably in a state of torpor. If this annual deficit of six months' life were really lost to the creature, it might look like very poor economy—a cowardly waste of time, not to be compared with the robust aliveness of the Red-squirrel. He keeps on going, however cold and boreal be his little world; he loses nothing in the way of thrills that life can give. He drinks the flush-red bumpers—all of them—till he has drained the last dregs, sensed every joy and fear; then dies—dies game and fighting. For such is the Red-One's way.

---

[24] Heller Mamm. Alaska, 1908, p. 339.

[25] Revision, p. 11.

[26] Athabaska-Mackenzie, N. A. F., 27, 1908, p. 161.

[27] Glacier Park, p. 52.

Contrasted with this, we have on the same range, his giant cousin, the Great Gray Chuck, who deliberately elects and prepares to pass the half of each year—the hard-rub half—in blank forgetfulness. No terrors in the winter sleep are there for him, so the wise Whistler assumes it as soon as the outside world becomes too bleak and cold for comfort. Very early, indeed, this seems to us; but remember he lives up high and far north. Right after the rich harvests of the hills have spread their lush abundance, so that the Marmot is fat—hog-fat—butter-fat—rounded and rolling—every tissue in his body, bones, and bundling, soaked, gorged, and oozing with fat—he hies him to his subsoil cell.

Is he wise and winning; or is he a fool, and losing half his life through cowardice?

Convincing evidence there is that, during lethargy—the little death of the winter sleep—the vital functions are suspended—the sleeper neither grows, suffers, wastes, nor ages. He did not lay up stores of food; yet, in the spring, he comes out just as fat as he went in the fall before.

If, then, the Powers-that-Be have allotted to the Marmot five full years of life, and he elect to live that life in ten bright summertimes, then must he spend the six dark months each year in deathlike sleep. And this he does, in calm, deliberate choice.

Oh, happy Whistler of the Peaks! How many of us would do the very same, were we but given choice.

So sleeps he, comfortably curled in a warm, safe bed during the time of terrible hardship, stress, and peril. The spring returns, and he comes forth. He has not suffered—not a whit; nor yet lost time, but held the flight of time on the Marmot clock. He comes out young as he went in.

What, by way of comment, can we say but "Wise Old Whistler!"

REFERENCES

1800–19—Journal of Voyages and Travels, by Daniel W. Harmon, pub. Toronto, 1904.

1829—Fauna Boreali-Americana, by Dr. John Richardson, I, pp. 150–51.

1866—Naturalist in Vancouver Island and British Columbia, by John Keast Lord, II.

1901—Natural History of the Cook Inlet Region, Alaska, by Wilfred H. Osgood, N. A. F., 21, p. 63.

1909—The Grizzly Bear, the Narrative of a Hunter-Naturalist, by William H. Wright.

1911—Wilderness of the Upper Yukon, by Charles Sheldon.

1912—Wilderness of the North Pacific Coast Islands, by Charles Sheldon.
1915—Revision of the American Marmots, by Arthur H. Howell, N. A. F. 37.
1918—Wild Animals of Glacier National Park, Wash., The Mammals by Vernon Bailey, Dept. Interior, Wash., pp. 50–53; 1 pl. of 2 figs.

LIFE LXXXI—THE LITTLE FLYING-SQUIRREL

	PAGE
Names	368
Description: Size, Colour	368
Races	369
Range	369
Haunts and Home Range	369
Abundance	369
Sociable and Gregarious	372
The Voice in the Night	373
Nocturnal	373
Food—Sometimes Flesh	373
Powers and Speed	375
Nesting Site and Nest	375
Pairing and Breeding	377
The Mother Love	378
Nursery Life	380
Gentlest of All Rodents	380
Playfulness	382
A Hope	384
References	384

Flying-squirrel, Southern Flying-squirrel, Little Flying-squirrel, White-furred Flying-squirrel, Assapanick, Assapan, Polatouche

Glaucomys volans (Linnæus)

(Gr. *glaukos*, gray; *Mys*, a Mouse; L. *volans*, flying)

[*Mus*] *volans* LINNÆUS, 1758, Syst. Nat., ed. X, I, p. 63.
Glaucomys volans HOWELL, 1915, Proc. Biol. Soc. Wash., Vol. XXVIII, p. 110, May 27.

TYPE LOCALITY—Virginia

One of the earliest notices records the Indian name in Virginia thus: "Squirrels as bigge as Rabbets, and other flying Squirrels, called Assepanick, which spreading out the legges and skins, seeme to flie thirtie or fortie yards at a time."[1]

The genus *Glaucomys* (Thomas, 1908) comprises nocturnal, squirrel-like animals, with large eyes and ears; clad in very soft, velvety fur; with tail flat horizontally, and with a *flying membrane between the fore leg and the hind leg*, on each side supported and enlarged by a spur developed from the pisiform bone.

$$\text{Teeth: Inc. } \frac{1-1}{1-1}\text{; prem. } \frac{2-2}{1-1}\text{; mol. } \frac{3-3}{3-3} = 22$$

When seen alive, *volans* looks like a very large Mouse, with big, black eyes, creamy breast, and smooth, flat, furry tail.

In addition to the generic characters, this creature has:

Size. Length, $9\frac{1}{8}$ in. (232 mm.); tail, 4 in. (101 mm.); hind foot, $1\frac{1}{4}$ in. (32 mm.).

Colour. All above, soft grayish fawn brown with blackish under-colour; all the body below, creamy white; on the sides, the blackish under-colour prevails over the fawn, till the edge of the flying membranes or wings is nearly unbroken blackish, which ends abruptly against the white underparts. The crown and upper part of the face are grayish like the back; the lower part of the face is whitish, with a black ring around each eye; the tail is dark brownish gray above, paler and grayer below; feet, gray on top, whitish on edges and underneath, with naked flesh-coloured soles in summer —clothed with hair in winter.

---

[1] Purchas, 1617 edition, Virginia, America, 8th Book, p. 945.

RACES

The following races have been described:

volans Linnæus, the typical form. T. l., Virginia.

saturatus Howell, like *volans*, but darker above, darker and grayer than *querceti*. T. l., Dothan, Ala.

querceti Bangs, like *volans*, but more uniform russet above; underparts, especially under the tail, strongly tinged russet. T. l., Citronelle, Fla.

texensis Howell, like *volans*, but more ochraceous above; like *querceti*, but with skull shorter, and smaller bullæ; paler than *saturatus*. T. l., Sour Lake, Tex.

goldmani Nelson, in colour like *saturatus*, with whitish muzzle; wings above, brownish; skull as in *volans*. T. l., 20 miles southeast of Teopisca, Chiapas, Mex.

RANGE

This species covers the wooded portions of the United States, as far west as the 95th meridian—where, virtually, the woods end; south to the Gulf of Mexico, and north to New England, southern Ontario, Wisconsin, and Minnesota; i. e., to the Canadian fauna.

To this, must be added the remarkable isolated area of *goldmani* in Chiapas, Mex.

HAUNTS AND HOME RANGE

This is essentially a species of the heavy timber, and is never found far from water. In every part of its vast range, it occurs in abundance where the above-named two essentials are found together.

Analogy and logic would ascribe a very small home range to the Flying-squirrel; and yet, Bachman's friend, Dr. Gideon B. Smith, informs us that it goes on journeys of a quarter of a mile or more.[2]

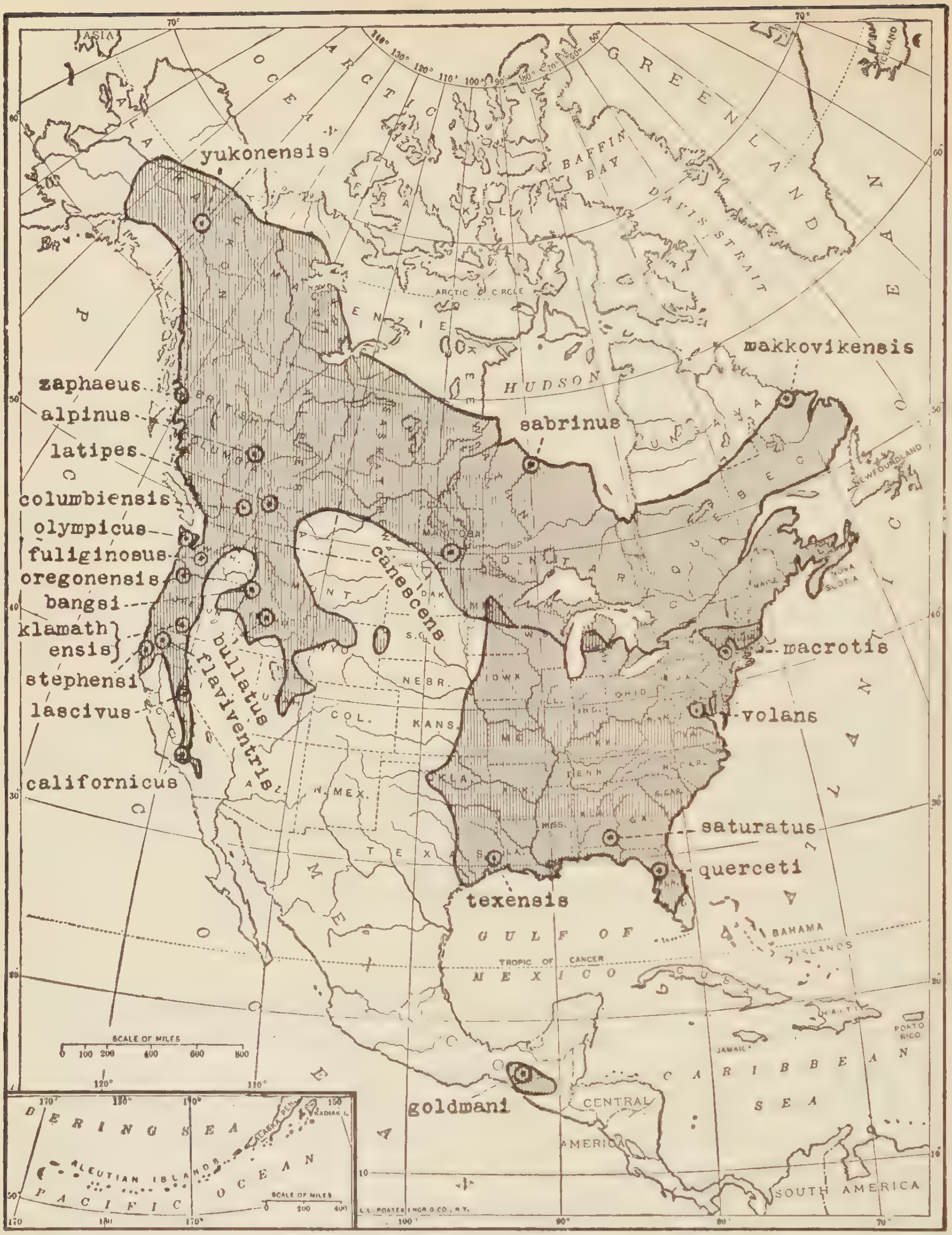
ABUNDANCE

Wherever found in its wide range, the Flying-squirrel exists in great numbers.

Dr. Gideon B. Smith, of Baltimore, says of the creature in his neigh-

---

[2] Q. N. A., I, p. 220.



MAP XI.—RANGE OF THE SOUTHERN FLYING-SQUIRREL AND OF THE NORTHERN FLYING-SQUIRREL

These overlap very slightly in Minnesota, South Michigan, New York, and Massachusetts

By E. T. Seton, with assistance of the Biological Survey, 1927

bourhood: "We caught so many of them one season that the young girls bordered their winter capes with their tails, which are very pretty."[3]

As will be seen later, Bachman describes an affair in which fully 200 Squirrels took part.

Evermann and Clark tell us, in the region about Lake Maxinkuckee, Ind., the species is especially abundant; and add: "It is remarkable the number of Flying-squirrels that can be discovered in any wood by knocking on the old dead snags of trees, particularly in the spring. We had found them in old oaks, beeches, maples, ash, willows, sycamores, and hickories, as well as in various old buildings."[4]

"Wherever there are, about the lake, large old trees with hollow trunks or limbs, one or more pairs of Flying-squirrels are likely to be found."[5]

In my Connecticut home woods, I have more than once found 3 Flying-squirrels' (*volans*) nests within a radius of 50 yards. This instance sheds some light on the creature's abundance—three families within 1 acre; and therefore, I should say that here, though it is rarely seen, the Flying-squirrel is more abundant than the Red-squirrel. Its secretive, nocturnal habits lead many to believe that it is not found in their locality, even though it may be the most numerous of its group.

An extraordinary chapter is contributed by F. M. Fryxell. Writing from Augustana College, Rock Island, Ill., he says: "It has become necessary in several cities of the Middle West, to wage war on Flying-squirrels; for in recent years, they have grown so numerous and troublesome as to constitute a civic nuisance. A press notice from Iowa City, Ia., in the fall of 1924, reported such a condition in that city. At about the same time, the writer was told that Flying-squirrels were very abundant in Davenport, Ia.; and an investigation showed that this was the case. One mystified resident from Davenport brought a couple of Flying-squirrels to the writer, and desired to know the name of the "funny Rats" that had invaded the premises and neighbourhood, and that were constantly being brought in by his Cat.

"During October of the present year (1925), Flying-squirrels have become quite troublesome to residents in the vicinity of Prospect Park at Moline, Ill. The small active rodents gain access through windows, crevices under the eaves, and similar apertures, to the attics of homes; and here, according to complainers, they make considerable noise at night. At first, residents in the neighbourhood thought that the night prowlers were Rats, but the capture of a few in rat-traps brought to light the true identity of the offenders. One citizen caught two during successive nights, but has continued to be annoyed by others which refuse to be caught."[6]

---

[3] Q. N. A., I, p. 220.

[4] Maxinkuckee, p. 16.

[5] As above, p. 14.

SOCIABLE AND GREGARIOUS

Wherever found, it lives in companies; and appears to be, in the full and proper sense, sociable, as well as gregarious.

Bachman writes: "In Carolina, we have generally found 6 or 7 in one nest; it is difficult, however, to count them, as on cutting down a tree which they inhabit, several escape without being noticed. In New Jersey, Pennsylvania, and Virginia, they appear to be more numerous, and the families are larger."[7]

To this, Kennicott adds: "It is gregarious, living in hollow trees in large companies. It usually prevails in greater numbers, wherever found at all, than is generally supposed."[8]

"On Dec. 16, 1890," say Evermann and Clark, "a family of 6 Flying-squirrels was found by Mr. J. M. Beck near Burlington. They were all full grown. On Thanksgiving Day, several years ago, Prof. U. O. Cox, then of Farmland, Ind., found 15 Flying-squirrels in a small rotten stump a little higher than a man's head."[9]

Dr. Gideon B. Smith, describing the creature's habits to Bachman, writes as follows: "They are gregarious, living together in considerable communities, and do not object to the company of other and even quite different animals. For example, I once assisted in taking down an old martin-box, which had been for a great number of years on the top of a venerable locust tree near my house, and which had some 8 or 10 apartments. As the box fell to the ground, we were surprised to see great numbers of Flying-squirrels, screech-owls, and leather-winged Bats running from it. We caught several of each, and one of the Flying-squirrels was kept as a pet in a cage for six months. The various apartments of the box were stored with hickory nuts, ches[t]nuts, acorns, corn, etc., intended for the winter supply of food. There must have been as many as 20 Flying-squirrels in the box, as many Bats, and we know there were 6 screech-owls. The crevices of the house were always inhabited by the Squirrels."[10]

---

[6] Journ. Mamm., May, 1926, p. 133.

[7] Q. N. A., I, p. 220.

[8] Quads. Ill., 1857, p. 70.

[9] Maxinkuckee, p. 16.

[10] Q. N. A., I, p. 220.

Their sociable nature, expressed in a merry game, is fully set forth in the section on Playfulness (p. 382).

The Voice in the Night

On the few occasions when I have heard the Flying-squirrel's call, it was a prolonged squeak not unlike the complaint of a red-eyed vireo whose nest is threatened.

Referring to the voices of the night, Merriam says: "The Shrew, the Mouse, the Bat, the Chickaree, and the Flying-squirrel are almost sure to be present, and the latter is generally responsible for no small share of the perplexing sounds. His activity is intense, his sailing leaps frequent, his gambollings almost ceaseless, his sly chuckle and saucy scold are occasionally heard, and his dropping of beechnut shucks is sometimes well nigh continuous."[11]

E. W. Nelson gives an admirable summing-up of this creature's calls, in the following paragraph: "Flying-squirrels have several notes, one of which is an ordinary *chuck, chuck*, much like that of other Squirrels. They also utter sharp squeaks and squeals when angry or much alarmed, and a clear musical chirping note, birdlike in character, which is frequently repeated for several minutes in succession, and is undoubtedly a song."[12]

Nocturnal

The true Squirrels, as a group, are children of the sun. With a few exceptions, they rise and retire when he does. The Flying-squirrels, on the other hand, are nocturnal. No one ever yet met with one that was voluntarily out and about in the woods during full daylight. *Volans* has the eyes of an owl, and sees perfectly at night, but suffers and hides in the day.

Food—Sometimes Flesh

Fundamentally, the food of the Flyer is vegetarian—corn, grain, seeds, fruits, berries, acorns and nuts; a certain amount of the last being necessary to keep its teeth in good shape. These are its choice, yet it many times departs from its stated faith.

Bachman writes: "Although the food of this species generally consists of nuts and seeds of various kinds, together with the buds of trees in winter, yet we have known many instances in which it manifested a strong desire for animal food. On several occasions, we found it caught in box-traps set for the Ermine, which had been baited only with meat. The bait (usually a blue-jay), was frequently wholly consumed by the little prisoner.

---

[11] Mamm. Adir., p. 199.

[12] Wild Animals of North America, 1918, p. 569.

"In a room in which several Flying-squirrels had been suffered to go at large, we one evening left a pine grosbeak (*Corythus enucleator*), a rare specimen, which we intended to preserve the following morning. On searching for it, however, next day, it was missing; we discovered its feet and feathers at last in the box of the Flying-squirrels, they having consumed the whole body."[13]

H. L. Stoddard contributes the following: "On April 6, 1914, an adult female Flying-squirrel (*Glaucomys volans*) was captured with her two young, and placed in a roomy cage in the workshop, with a section of tree trunk containing a flicker's hole as a nest. Two or three days later, a fine male yellow-bellied sapsucker was captured unhurt, and placed in the same cage, where he made himself at home on the stump.

"I was greatly surprised the next morning to find his bones on the bottom of the cage, picked clean. This strong, hardy woodpecker, in perfect health, had been killed and eaten during the few hours of darkness, by the old mother Flying-squirrel, though she had other food in abundance.

"While pondering the tragedy, visions of the many holes in the woods that had been found containing feathers and other remains of small birds came to mind, and I wondered if the beautiful and apparently inoffensive Flying-squirrels were responsible.

"Small birds frequently take refuge in old woodpecker holes and natural cavities, where they are at the mercy of such a nocturnal wanderer. I am aware that Flying-squirrels have been accused of eating birds' eggs and young birds, and while I have no positive proof that they prey on adult birds in a wild state, I have my suspicions; perhaps others have more conclusive evidence.

"My friend, Mr. L. L. Pray, tells me that 4 Flying-squirrels in his possession ate prodigious quantities of 'pinch-bugs' and other beetles, as much as a pint a meal. The wings and legs were cut off, and the bodies eaten. They also displayed a fondness for raw meat."[14]

To this, Bernard Bailey adds: "Near Elk River, Minn., July 4, 1920, I drove one [Flying-squirrel] out of a martin house, and shot it. The stomach contained meat and pin feathers. I had taken a young martin from the same house earlier in the day, which had been recently killed and partly eaten. Another young martin had been taken from the same house a week before, in the same condition. No young martins were left in the house when it was taken down at 2 P. M. The Squirrel was an adult female."[15]

---

[13] Q. N. A., I, p. 221.

[14] Journ. Mamm., Feb., 1920, pp. 95–96.

POWERS AND SPEED

Most of us are familiar with the far-gliding festoons that constitute the flight of this night brownie; and can describe it accurately. Yet there is something in Evermann and Clark's brief sketch that sets it in new, vivid light. "Occasionally," they say, "in the evening twilight or on moonlight nights, a Flying-squirrel may be seen sailing in a gentle downward curve from one tree to another, the start being made from well toward the top of one tree, and the place of alighting at a much lower point on the other. There is something ghostlike in this gliding flight; it is so unlike that of any other of our native creatures. There is not only an entire absence of fluttering wings, but perfect silence."[16]

How far can the Flyer go in one flight? I have seldom seen more than 20 or 30 feet covered, though Bachman says 50 yards.[17] As we shall see in the section on the Mother Love, one little mother volplaned, and carried a young one from one tree to another 86 feet away.

So far as known, the Flying-squirrel is helpless in the water. No one has recorded the creature swimming, and many of this species have been found drowned in buckets and tiny water holes from which a few strokes would have rescued them.

This has a bearing on the fact that there are no insular races of the species.

NESTING SITE AND NEST

Nine-tenths of the Flying-squirrels I have flushed were driven from woodpecker holes when I pounded on the tree—knocked at the door to see who was in the house. There can be no doubt that these are the favourite nesting sites, although sometimes a hollow limb or an accidental rot-hole serves. Usually this is 20 or 30 feet from the ground, and is completely lined with shredded cedar bark or other soft material.

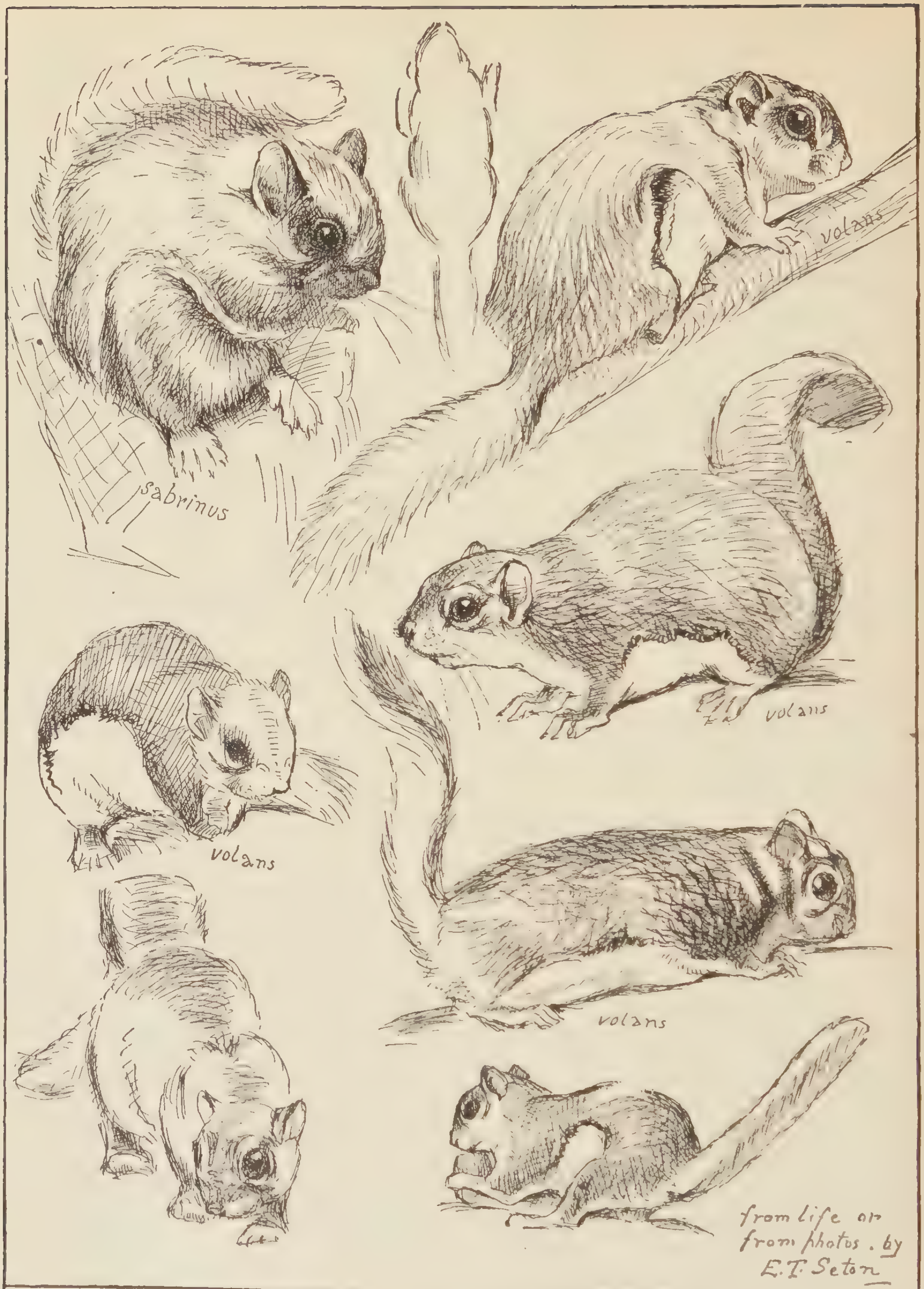
There is, however, another, though kindred place, as Evermann and Clark say of the summer colony at Lake Maxinkuckee, Ind. "Late in the fall, after the cottagers have left the lake, and the cottages have been closed for the winter, these resourceful little animals sometimes take up their resi-

---

[15] Journ. Mamm., May, 1923, p. 129.

[16] Maxinkuckee, p. 15.

[17] Q. N. A., I, p. 218.



from life or
from photos. by
E. T. Seton

Plate XLI Flying-squirrels - various poses.

dence in the loft, cupboard, or some suitable box in the cottages. There they build their nests and dwell cosily until the warm days of returning spring tempt them to return to a hole in some scraggy old oak near by, where they will spend the summer."[18]

So, also Bachman says: For nesting sites, they "confine themselves to a hollow, or some natural cavity in the branches or trunk. We have very frequently found them inhabiting the eaves and roofs of houses, and we discovered a considerable number of them in the crevices of a rock in the vicinity of the Red Sulphur Springs in Virginia."[19]

Bachman says it never builds a nest of leaves on the trees like the true Squirrels.[20] Kennicott reiterates the notion, saying: "It does not build nests of leaves among the branches, like the true Squirrels. I am informed by Mr. Brendel, of Peoria, however, that a female was observed by him to bring forth in a deserted bird's nest."[21]

Then, as usual when we announce a hard-and-fast rule, the shattering exception comes crashing through our line. L. L. Snyder, of Toronto, writes:

"During the summer of 1920, I spent several weeks at Point Pelee, Ont., collecting material for small habitat groups. On June 24th, I found the outside nest of a Flying-squirrel (*Sciuropterus volans*) in a small tree covered with climbing bitter-sweet. A tall walnut tree four feet away, gave the elevation necessary for the Squirrels to 'fly' to their permanent home, which was in a natural cavity of an oak 60 feet distant. . . .

"The nest was constructed entirely of red cedar bark, and lined with fine, soft shreads of the same material. It was roughly ovate in shape, with the entrance near the top, at the end towards the tree trunk. The branches and vines supported it from all angles against the wind, and its compact structure and sheltered position in the vine made it fairly waterproof."[22]

One location has not yet been invaded by the Flyer. No one has recorded it taking refuge, Chipmunk-fashion, in a hole underground.

PAIRING AND BREEDING

So far as known, most Squirrels pair when in a state of nature or in congenial artificial surroundings. In the case of the Flying-squirrel, all observations seem to indicate that a pair are found together at nearly all seasons. Whether or not they pair for life, is not known.

---

[18] Maxinkuckee, p. 14.

[19] Q. N. A., I, p. 221.

[20] As above.

[21] Quads. Ill., 1857, p. 70.

[22] Journ. Mamm., Aug., 1921, p. 171.

The mating season is apparently mid-March in the Northern States, and February in Dixieland.

Dr. L. D. Powers found that "among domesticated Flying-squirrels, mating season begins at the end of December, and occurs throughout the summer, varying with the individuals. The last young to be born during one season, arrived early in September."

"Their progeny," says Merriam, "must be brought forth early in April, for on the 30th of April, 1878, Dr. C. L. Bagg and myself took 3 half-grown young from a woodpecker's hole, about 15 feet above the ground, in a decayed stub."[23]

As already noted, the favourite nesting place is a hole in a tree. Here, after approximately 40 days' gestation, are born the young.

"This species," says Bachman, "has from 3 to 6 young at a time. We have been assured by several persons that they produce young but once a year in the Northern and Middle States. In Carolina, however, we think they have two litters in a season, as we have on several occasions seen young in May and in September."[24]

Evermann and Clark say: "They seem to breed chiefly early in the spring, about sugar-making time. A second or third litter may be produced later in the season."[25]

C. S. Brimley, of Raleigh, N. C., gives the following record: "Three lots of 2 young each, one lot of 3, and one of 4, taken in April of 1891 and 1892. (One lot of 3 from Bertie Co., N. C., March 20, 1893.) One lot of 4 young Sept. 10, 1892. The young all came from nests in hollow trees or limbs, sometimes only a few feet from the ground, sometimes high up."[26]

The Mother Love

Prof. J. W. Stack, of East Lansing, Mich., has given a most interesting account of a Flying-squirrel family. Like all such, it ascribes to the mother the highest possible development of maternal love and devotion.

"Several forestry students," he says, "were trimming trees along the river, May 20, 1924, when one of them sawed off a dead limb, exposing a Flying-squirrel's nest. The mother Squirrel left the nest, and climbed to the top of the tree. The student lifted the nest from the cavity, and carried it to the ground.

---

[23] Mamm. Adir., p. 201.

[24] Q. N. A., I, p. 221.

[25] Maxinkuckee, p. 16.

[26] Journ. Mamm., Nov., 1923, p. 263.

"The four young were not more than one-third grown, as their eyes were not open, and their bodies only scantily haired. The class of 8 students gathered around to observe them. While they were so engaged, the mother sailed to the foot of a tree on the opposite side of the river, and immediately climbed to the top, where she made a diligent search for a suitable hole along the four large branches and trunk.

"The students were surprised next to see the parent sail to their side of the river, light at their feet, and immediately climb the pants leg of the student holding the nest and young. She grasped one of the young ones in her mouth, climbed down to the ground, went to the top of a near-by tree, volplaned [80 feet] across the river, and carried the young one to one of the holes she had previously investigated. This trip was made four times, and each time the mother lighted near the class in approximately the same spot, and also used the same starting point on the trees each time. Only once did she ascend the wrong pants leg.

"In order to check up the points of the above observation, and also to obtain motion pictures of the procedure, I visited the new nest site on June 2, 1924, and found that the young were fully haired, and a heavy load for the mother to carry. By using her mouth and fore limbs, she rolled the young into a ball, always placing the back to her ventral side. She repeated the actions of the first occasion, except that instead of crossing the river, she picked out a new home in a tree 30 feet down on the same side of the stream. The male Squirrel was not seen on any of the three occasions."[27]

Bachman quotes from D. W. C.,[28] who published a long account of his captive Flying-squirrel. This writer wished to test the mother's ability to transport her young; and says: "We often took the young Squirrels out of their nest, for the purpose of watching the mother carry them away, which she did by doubling the little one up under her body with her fore feet and mouth, till she could take hold of the thigh and the neck, when she would jump away so fast that it was difficult to see whether she was carrying her young one or not.

"As the young increased in size (which they soon do) and in weight, the undertaking became more difficult. We then saw the mother turn the young one on its back, and while she held the thigh in her mouth, the fore-legs of the young one were clasped round her neck. Sometimes, when she was attempting to jump upon some earthen pots which I had placed in the cage, she was overbalanced and fell with her young to the ground; she would drop the young Squirrel, so as to prevent her own weight from crushing it, which would have been the case if they had fallen together. I have seen the young ones carried in this manner till they were half-grown."[29]

---

[27] Journ. Mamm., May, 1925, pp. 128–29.

[28] Loudon's Magazine, Vol. IX, p. 571.

Nursery Life

Evermann and Clark say: "While in their nests, these Squirrels do more or less squeaking. On the night of Sept. 21, 1903, one or more were heard in trees in the Arlington Hotel grounds. . . .

"On Aug. 19, 1906, while riding along a road west of the lake, a squeaking sound attracted attention to the base of a small scrub oak at the roadside. On examining the place, four young Flying-squirrels were discovered. They were quite small, and wholly naked. A storm had probably blown them from their nest, which was a large, globular affair, made of fibrous material, situated in a crotch of a tree. While we were only a few feet away, one of the parent Squirrels, presumably the mother, came down the tree, and, taking the young in her mouth, carried them, one at a time, back to the nest.

"On April 16, 1890, one of us found a nest containing two young Flying-squirrels, south of Terre Haute. The nest was in a woodpecker's hole about 20 feet from the ground in a maple. Upon striking the tree, the mother Squirrel came out of the hole and flew to another tree near by, where she remained watching. Breaking the snag at the hole, the two young were removed and placed on the ground. After a little time, the old Squirrel flew back to the snag, and seemed much disturbed by the changed appearance of things. She looked all about, and, finally discovering the young on the ground, she came down, and taking one in her mouth, carried it to the top of the snag, from which she then flew with the young in her mouth, to another tree about 30 feet away. She ran up that tree to a height of about 50 feet, where she found a knot-hole in which she placed the little one. In a moment, she reappeared, and flew back to the snag for the other. In the meantime, I had stationed myself near the young. After several advances and retreats, she finally came and seized the young in her mouth, when I caught her in my hand. When released, she returned to the knot-hole with the young Squirrel.

"These dates (April 16th and August 19th) are of interest in showing so wide a range in the breeding season of the Flying-squirrel."[30]

Gentlest of All Rodents

The kind, confiding disposition of the Flyer is in full accord with its happy social life. The gentlest of all rodents on our list it is. Not even the

---

[29] Q. N. A., I, p. 222.

[30] Maxinkuckee, pp. 15–16.

Rabbits are milder or more trusting. Molly Cottontail will tear you with her hind claws if you seize her in your hands. The true Squirrels will gash your fingers to the bone if you come too near. But Assapan, the Flyer, will rarely bite or scratch; and quickly ceases to struggle if assured that you mean to do him no grievous harm.

Dr. Gideon B. Smith, of Baltimore, says: "The docility of the one we kept as a pet was remarkable; although he was never lively and playful in the daytime, he would permit himself to be handled and spread out at the pleasure of anyone. We frequently took him from the cage, laid him on the table or on one hand, and exposed the extension of his skin, smoothed his fur, put him in our pocket or bosom, etc., he pretending all the time to be asleep.

"It was a common occurrence that these Squirrels flew into the house on a summer's evening, when the windows were open, and at such times, we caught them. They were always perfectly harmless. Although I frequently seized them in my hand, I was never bitten."[31]

In Merriam's words: "A more gentle, docile, and graceful animal than the Flying-squirrel does not exist; and though without anything striking in the way of colour or markings, it is nevertheless one of the most beautiful of our mammals."[32]

Speaking of his pet Flying-squirrels, Prof. F. H. King says: "I have never known wild animals that became so perfectly familiar and confiding as these young Squirrels did; and they seemed to get far more enjoyment from playing upon my person than in any other place, running in and out of pockets, and between my coat and vest. After the frolic was over, they always esteemed it a great favour if I would allow them to crawl into my vest in front, and go to sleep there, where they felt the warmth of my body, and it was very rare indeed, during the first six months, that they failed to ask the privilege; indeed, they came to consider themselves abused if I turned them out. When forced to go to sleep by themselves, the attitude taken was amusing—the nose was placed upon the table or other object it happened to be upon, and then it would walk forward over it, rolling itself up until the nose almost protruded from between the hind legs; the tail was then wrapped in a horizontal coil about the feet, and the result was an exquisite little ball of life in soft fur which it seemed almost sacrilegious to touch. If they escaped from the cage during the night, I was sure to be warned of the fact by their coming into the bed to roll themselves up close to my face or neck."[33]

---

[31] Q. N. A., I, p. 220.

[32] Mamm. Adir., p. 198.

[33] Amer. Nat., XVII, No. 1, Jan., 1883, p. 39.

Playfulness

Prof. George H. Perkins, of the University of Vermont, writes of certain Flying-squirrels that he kept in his home: "All night long, often with only the briefest rest now and then, these little animals are in vigorous motion, jumping, bounding, capering, running with ever-varying movement and astonishing energy. Everything they do is done with all their might. It would seem to anyone watching them that the exercise of the first few minutes must wholly exhaust their powers; but, on the contrary, the more their muscles are used, the more capable of use they seem; and great as is the energy of their movements at first, they usually increase in vigour and speed until after midnight, and scarcely grow less before morning. Nothing affords them so much gratification as a large wheel which is placed inside the cage."[34]

In this, they found such prolonged and riotous fun that he "made some experiments . . . and found that the usual rate of revolution was from 60 to over 120 times a minute; and, as the wheel is 44 inches in circumference, when its rate is the latter of the two numbers named, the Squirrel turning it must travel 440 feet a minute, or about 5 miles an hour."[35]

The inevitable wilfulness of a highly sentient being is illustrated in the following: "Now and then," says the Professor, "the freak takes one or the other to leave the wheel altogether for several days, and in the meantime they relieve their over-buoyant feelings by executing a brilliant series of somersets, with an agility and daring that would excite the envy of the most skilful acrobat. They always turn backward, going completely over, and alighting almost exactly upon the spot from which they started. Now they run a few steps before going over, and now stop and turn around as if a spit ran through the centre of the body, on which it turned."[36]

In summing up the ways and life-joy of these merry night-frolickers, Prof. Perkins says: "Certainly it is not easy for words to represent the merry, rollicking, don't-care manner in which they do everything. Such a combination of earnestness and carelessness is seldom seen. For they are earnest about their work, and in emptying a box of nuts, they seem to feel the great importance of their undertaking, and the necessity of soberness and dignity in its execution; but yet one cannot help seeing that all this is but assumed for the occasion, for their eyes, and indeed their whole body, are all the time expressive of mischief; and the little rogues are never so sedate that they do not seem to be bubbling over with fun, and to be ready at a moment's notice to engage in any mischief that may occur to their scheming little heads."[37]

---

[34] Amer. Nat., VII, No. 3, March, 1873, p. 133.

[35] As above, p. 134.

[36] As above, p. 135.

R. Hertzberg, a Stamford, Conn., naturalist, describing the family of Flying-squirrels he had tamed and studied, says: "They are full of tricks, and play together much like puppies or kittens, scratching and squealing and chasing one another. Often one steals the nuts from the other's mouth.

"One evening before sunset, we heard a great squealing outside the Kamp. With the exclamation, 'Something has got the Baby!' we rushed out, only to find his highness perched on his board and calling for his supper.

"Another evening, when all but the last nut had been taken off the board, I saw one of our Babies come down, get the nut and run away. Suddenly, he reappeared, and tried with all his might to push the nut between the edge of the board and the tree. His action was so unusual that I examined the nut, and found it to be a pignut. The rascal evidently desired to express his disapproval of such food by promptly returning it."[38]

The fact that, in a state of nature, they have even more joyful high jinks, and on the largest social scale, is illustrated in Bachman's own observations. He was seated on a log in the woods near Philadelphia. It was just after sunset on a warm evening in early autumn. "The common Red Bat was on the wing," he says; "still, for some time, not a Flying-squirrel made its appearance. Suddenly, however, one emerged from its hole, and ran up to the top of a tree; another soon followed, and ere long, dozens came forth, and commenced their graceful flights from some upper branch to a lower bough. At times, one would be seen darting from the topmost branches of a tall oak, and with wide-extended membranes and outspread tail, gliding diagonally through the air, till it reached the foot of a tree about 50 yards off; when at the moment we expected to see it strike the earth, it would suddenly turn upwards, and alighted on the body of the tree. It would then run to the top, and once more precipitate itself from the upper branches, and sail back again to the tree it had just left. Crowds of these little creatures joined in these sportive gambols; there could not have been less than 200. Scores of them would leave each tree at the same moment, and cross each other, gliding like spirits through the air, seeming to have no other object in view than to indulge a playful propensity. We watched and mused till the last shadows of day had disappeared, and darkness admonished us to leave the little triflers to their nocturnal enjoyments."[39]

---

[37] Amer. Nat., VII, No. 3, March, 1873, p. 139.

[38] Guide to Nature, April, 1916, p. 345.

[39] Q. N. A., I, p. 218.

L. A. Fuertes, the artist, tells me that he has many times witnessed this very scene in the woods about his home at Ithaca, N. Y.

A Hope

In my quest for understanding of the little wild souls round us, I feel I am going wisely. I am conscientiously collating the accounts of a hundred other men—patient wood-witnesses, good naturalists all. For I myself have not been privileged to see the things they saw.

Yet no one has done justice quite to our wild kinsfolk of the woods, even though they are everywhere about us. I am, indeed, through other eyes, appraising, measuring, recording for each its place in the scheme, its hold on life, its answer to the riddle of the daily stress. But I do not—for I cannot—give light on the biggest of all questions: How far has each small mind upclomb? What is its outlook on the world about?

When one gathers cocoons in the early springtime, most of them are light and hollow; but now and then is found one that is heavy, firm, and full. And we know that this has life—it holds a quick thing, ready soon to fly in the heavens above.

As I scan these tales, I fear me many are but dead cocoons; yet do I feel in this that tells the Flying Merry-maker's way, in measure seldom seen, are one or two that have the breath of life. And I have hopes that this brief telling will inspire some younger field-man to go forth, and seek out other quick cocoons.

References

1849—Quadrupeds of North America, by Audubon and Bachman, I, pp. 216–22; 1 ill.

1884—Mammals of the Adirondacks, by C. Hart Merriam, pp. 197–206.

1911—Notes on the Mammals of the Lake Maxinkuckee Region, by Dr. Barton Warren Evermann and Howard Walton Clark. Proc. Wash. Acad. Sci., Feb. 15, pp. 14–16.

LIFE LXXXII—BIG FLYING-SQUIRREL

PAGE
Names 386
Description: Size, Colour 386
Races 387
Range, Haunts, and Home Range 388
Sociable and Numerous 388
Voice 389
Powers and Gifts 389
Enemies 390
Food 390
The Climax of Blood-thirst 391
A Strange Happening 391
Home and Young Ones 392
Kindliness 393
His Way of Life 393

References 394

Big Flying-squirrel, Northern Flying-squirrel, Canadian Flying-squirrel, or Severn River Flying-squirrel

Glaucomys sabrinus (Shaw)

(Gr. *Glaucomys*, see *ante;* L. *sabrinus*, of Severn River)

Sciurus sabrinus Shaw, 1801, Gen. Zool., II, p. 157.
[*Glaucomys*] *sabrinus* Howell, 1915, Proc. Biol. Soc. Wash., Vol. XXVIII, p. 111, May 27.

Type Locality—Mouth of Severn River, Ontario, Canada

French Canadian, *l'Asapan; le Polatouche; l'Ecureuil volant.*
Cree, *Shą-ka-skan'-da-way-o.*
Ojibway and Sauteaux, *Sha-ka-skan-da-way* (flying downward).
Yankton Sioux, *Poh-kahn.*
Ogallala Sioux, *Psin-cha.*

In addition to the generic characters, the Canadian Flying-squirrel has:

Size. Total length, 12 in. (305 mm.); tail, 6 in. (152 mm.); hind foot, 1½ in. (38 mm.).

Colour. Its general colour above is soft fawn-brown, much broken with the lead-coloured under-fur showing through, especially on the upper side of the wings. Toward the edge of these flaps, the colour becomes a very dark blackish brown, which forms a band, and ends sharply against the white of the under sides.

The underparts of the animal are white, but *next the body the fur is a dull leaden gray.* The under side of the tail is more or less tinged with fawn colour, and there is a blackish ring around each eye.

In winter, it is much browner above, and tinged with yellow beneath.

Female is similar.

The leaden under-fur of the present species sharply distinguishes it from *volans*, in which the breast fur is wholly pure white. The greater size of the present is another good feature; especially is this noticeable in the tail.

RACES

The following races of *sabrinus* are recognized in Howell's Monograph:

sabrinus Shaw, the typical form. T. l., mouth of Severn River, Hudson Bay, Ont.

makkovikensis Sornborger, like *sabrinus*, but larger and darker. T. l., Makkovik, Lab.

macrotis Mearns, like *sabrinus*, but smaller. T. l., Catskills, N. Y.

canescens Howell, like *macrotis*, but much paler. T. l., Portage la Prairie, Man.

bangsi Rhoads, like *sabrinus*, but more drab above, and pinkish cinnamon below; more vinaceous above than *alpinus*. T. l., Idaho Co., Ida.

alpinus Richardson, like *sabrinus*, but grayer above; tail darker; skull larger. T. l., Jasper House, Alta.

yukonensis Osgood, like *sabrinus* in colour, but larger; upper parts more ochraceous than in *alpinus*. T. l., Yukon River, near Alaska-Canada boundary.

zaphæus Osgood, like *alpinus*, but more brownish above, and darker below. T. l., Helm Bay, Cleveland Penin., Alas.

oregonensis Bachman, like *zaphæus*, but colours more rufescent above and below. T. l., probably, near St. Helens, Ore.

columbiensis Howell, like *sabrinus*, but soles of hind feet often yellow, much paler than *oregonensis;* more vinaceous than *klamathensis*. T. l., Okanagan, B. C.

fuliginosus Rhoads, like *columbiensis*, but more brownish, less rufescent than *oregonensis*. T. l., Cascade Mts., near Martin Station, Wash.

latipes Howell, like *fuliginosus*, but larger and darker. T. l., Glacier, B. C.

olympicus Elliot, like *fuliginosus*, but much darker, much less rufescent than *oregonensis*. T. l., Happy Lake, Olympic Mts., Wash.

bullatus Howell, like *klamathensis*, but larger, more pinkish above, more brownish beneath; like *bangsi*, but much larger and more pinkish above. T. l., Sawtooth (or Alturas) Lake, Ida.

klamathensis Merriam, like *fuliginosus*, but paler above; soles and underparts yellowish; like *bullatus*, but paler, with smaller bullæ. T. l., Ft. Klamath, Ore.

flaviventris Howell, like *klamathensis*, but smaller; all below, tinged yellow. T. l., Bear Creek, Trinity Co., Calif.

lascivus Bangs, like *flaviventris*, but smaller, and without yellow tinge below; like *stephensi*, but paler. T. l., Tallac, Calif.

californicus Rhoads, like *lascivus*, but paler and grayer above. T. l., Squirrel Inn, San Bernardino Mts., Calif.

stephensi Merriam, like *lascivus*, but more reddish above, soles whiter; less reddish than *oregonensis*, smaller than *fuliginosus*. T. l., Sherwood, Mendocino Co., Calif.

Range, Haunts, and Home Range

Map XI (p. 370) shows the Northern Flying-squirrel to be a creation of the Canadian Fauna. The species follows that life-zone with almost complete accuracy. The range of the form *canescens* in the Red River region, however, is a southward encroachment into the Alleghanian.

Within these limits, the variety of surroundings and its sedentary habits have split it up into an unusual number of races—no less than 19.

The haunts of these Flying-squirrels is always in and about heavy timber, with water near by. I have never seen or heard of Flying-squirrels far away from large timber. Here the hollow trunks, or woodpeckers' holes, afford its favourite nesting places. It is so nearly dependent on the woodpeckers for its tenement quarters that it will not be found where no woodpeckers are.

I have never known the species to harbour in rocks or caves, although it is very ready to find a lodging about human dwellings.

I have no direct evidence on the home range of this species, but analogy with other Squirrels and the absence of any migratory habit lead me to believe that the Flying-squirrel is content with a domain of two or three acres.

Sociable and Numerous

Like its Southern kinsman, this bright-eyed child of the night is both sociable and gregarious. In Dec., 1882, I found 9 adults living in one stub at Carberry. They were so close together that a rifle ball fired by my companion at the stub below their hole, killed 4 and wounded another of the 9. They were undoubtedly profiting by each other's company for warmth; therefore, this animal is somewhat sociable.

W. E. Cram writes of the species about his home in Hampton Falls, N. H.: "Here a dozen or more of them will occupy the same hollow tree, and I have heard of as many as 40 being driven from the same hole."[1]

---

[1] American Animals, 1902, p. 177.

Nelson says that "trappers in Montana who run long lines of traps for Marten through the mountain forests, capture hundreds of these Squirrels in a single season."[2]

Whether the species indulges in the flying-carnival described in the Life of the Southern Flying-squirrel, has not been determined. But the analogies are strong, and make for similarity; therefore, I expect to find that this creature holds social carousel among the trees, just as its cousin does.

VOICE

The Lesser Flying-squirrel is, as we have seen, extremely vocal; and, when equally observed, we shall doubtless find that the present is not less so.

G. G. Goodwin tells thus of two that he trapped in Gaspé, Que.: "Both specimens were alive when I took them out, and fought viciously, uttering shrill cries. Late one night, I heard one making a similar cry as it passed close by the camp in the woods; from the speed with which the intensity of the call died out, the animal must have been travelling very rapidly, as in a short time the sound died away in the distance."[3]

POWERS AND GIFTS

There is, of course, nothing of true flight in the performance of this Squirrel. It is the prototype of the glider; it shoots from tree to tree, kiting on its flat-spread membranes. It will start at an angle of about 30 degrees to the perpendicular trunk; but the course becomes more level as it goes, till it is gliding horizontally, and at last a little upward; landing about as far from the starting point as it is below it.

The widest space I have seen covered in such flight, is 20 or 30 feet; others report much greater distances.

The few of this species that I have observed in daylight were far inferior to the Red-squirrel in activity. Bachman mentions[4] that at Quebec, he heard of one that "was caught alive by a soldier, who saw it in the Plains of Abraham, and ran it down." But it is scarcely fair to judge the swiftness of a night animal by its poor speed in the dazzling day.

Unlike the day Squirrels, this species is apparently a poor swimmer. Merriam says: "They are thirsty creatures, and, in the early spring, when certain of the woodsmen are engaged in making maple sugar, many are found dead in the sap buckets—drowned in their efforts to obtain the sweet fluid."[5]

---

[2] Wild Animals of North America, 1918, p. 568.

[3] Journ. Mamm., Nov., 1924, pp. 256–57.

[4] Q. N. A., III, p. 203.

So many specimens have been found drowned in cisterns and wells, that one is forced to believe that it has bartered its power in the water, and to some extent its activity on land and in the trees, for its very limited mastery of the air. This, no doubt, accounts in part for the fact that in North America, the Flying-squirrel is practically confined to the mainland. There are no island forms or colonies.

ENEMIES

Owls, Foxes, Martens, and Weasels are to be numbered among the enemies of this gentle creature.

J. S. Charleson writes me that in Jan., 1905, T. S. Kittson shot a barred owl in Riding Mountain, Man., and found in its stomach a Flying-squirrel.

Many a one falls victim to the House-cat. It often happens that seeing the creature in Tabby's jaws, is the first intimation one has of their presence in a given neighbourhood.

Prof. John Macoun tells me that in British Columbia, he once found the body of a Flying-squirrel in a trout. It would be interesting to know whether the trout simply potted him as he struggled helplessly in the stream, or captured him as he swooped above the pond, to be taken by the fish in one vast trout-leap worthy of a game and sporting fish.

FOOD

The food of the species may be divided into normal and abnormal. But soon we find the latter so usual and important that we move it into the former class, as will be seen.

Nuts are doubtless the favourite food of this bright-eyed night-prowler; but where these are scarce, as in northern Manitoba, spruce seeds probably are its mainstay.

In Ontario, according to Soper, "they thrive on sweet apples all winter long, and seem to require nothing else to keep in condition."[6]

There is, indeed, every reason (except direct evidence) to believe that the Northern Flying-squirrel, like its relative, will eat bark, buds, fruit, seeds, nuts, acorns, insects, birds, or meat—is, indeed, perfectly omnivorous.

---

[5] Mamm. Adir., p. 207.

[6] Journ. Mamm., Nov., 1923, p. 249.

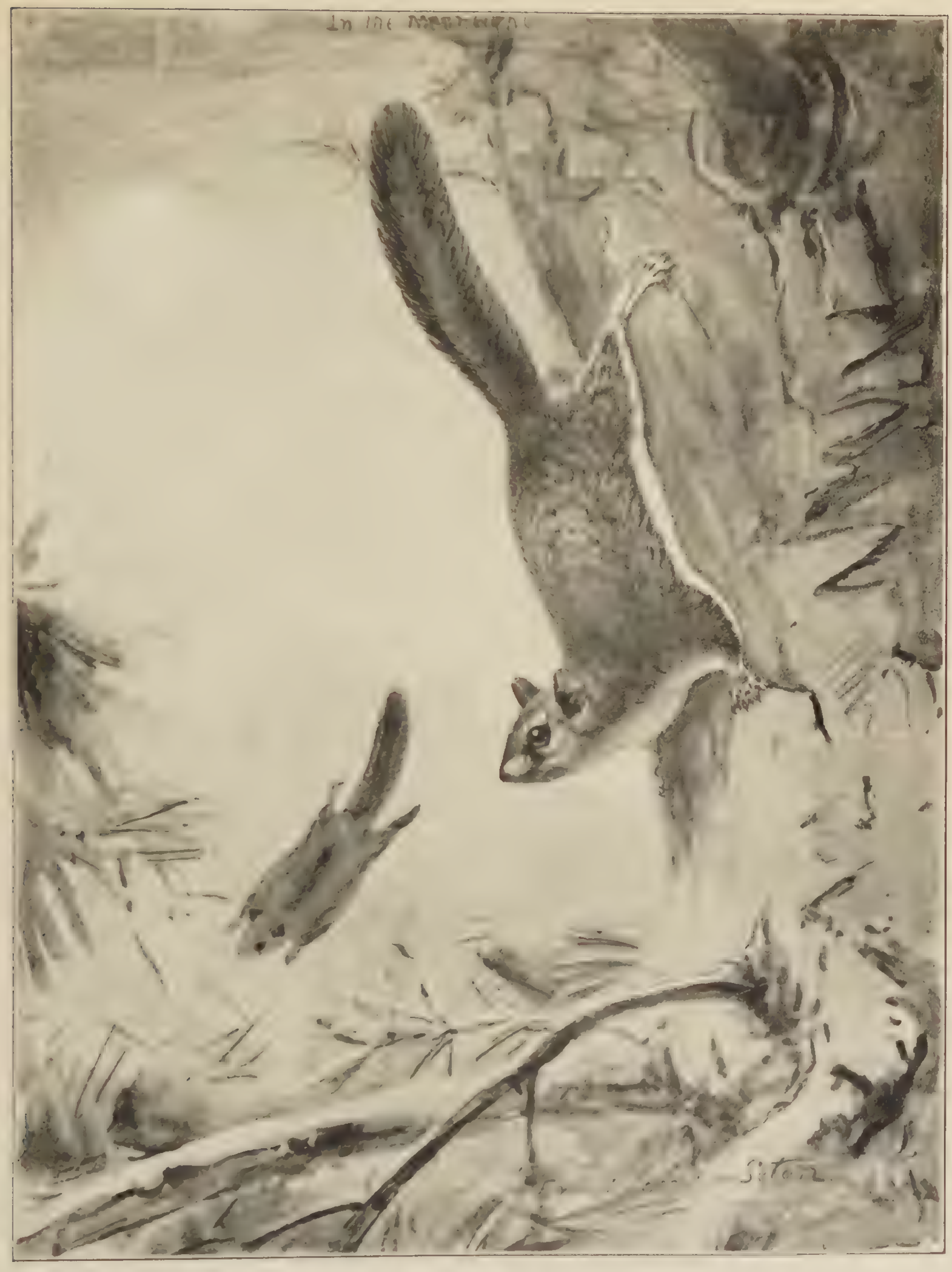


PLATE XLII.—NORTHERN FLYING-SQUIRREL

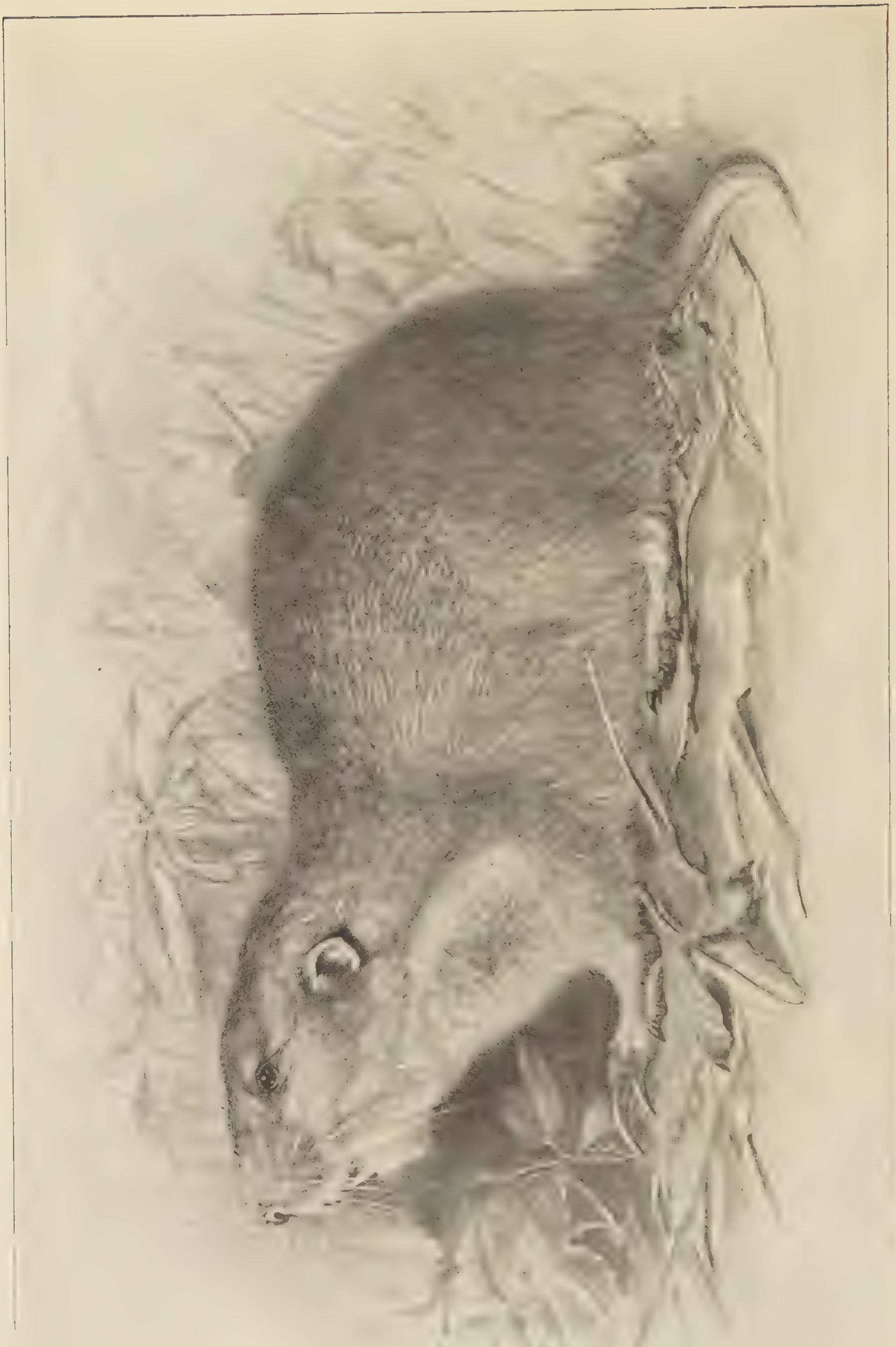


PLATE XLIII.—POCKET-GOPHER ♀ ($\frac{5}{6}$ LIFE SIZE)

(*Thomomys talpoides* (Rich.))
Carberry, Man., 1892
From drawing made for Report, U. S. Biological Survey, Dep. Agr. (1892), 1893

THE CLIMAX OF BLOOD-THIRST

There is no species addicted to meat-eating that does not, soon or late, cannibalize. A friend of Edward Breck, the Nova Scotia naturalist, sent him a captive Flying-squirrel with 3 little ones. He writes: "One of the little ones was dead when we placed the nest in its destined box, and a second died during the evening. Corn and water were provided, and the Squirrel drank greedily and ate some corn. She then proceeded to eat the dead little one that had not yet been removed from the nest on the chance of its living, and devoured it nearly completely. . . . I will add that during the night, the remaining young one was transferred by the mother to the dark receptacle at the top of the cage which was placed there for this purpose, and eating and drinking seemed to go on normally."[7]

A still more morbid development of the craze is seen in the following, by L. R. Dice in his paper on Alaska Mammals. A Yukon Flying-squirrel, he says, "was trapped Oct. 15, 1911, and two Nov. 2, in a white spruce and paper-birch forest in the hills 8 miles north of Tanana. One specimen was taken in a steel trap set near a stump, and baited with a grouse head. This animal and another specimen caught at the same place in a Mouse trap, had bitten off and destroyed their tails before dying. A third specimen caught in a Rat trap and held in such a manner that it could not reach its tail, was in perfect condition."[8]

A STRANGE HAPPENING

The following curious incident may or may not be a food item. It is from the pen of "Prowler" (Frank H. Risteen), and refers to the present species in New Brunswick.

"An odd experience," he says, "befell Mr. Hunter during his return from a hunting trip to the settlement last fall. One evening, he left a candle burning on the table in the Forty-Nine-Mile Camp while he went out to the hovel to look after the Horses. To his surprise, when he returned to the camp, the candle was not only extinguished, but could nowhere be found! Mr. Hunter is not entirely free from the influence of the wild, weird legends peculiar to the backwoods of the Miramichi, especially those that relate to a fabulous monster known as the 'Dungarvon Hooper.' He lit another candle, however, and went out to attend to his team. When he came back he found that the second candle had vanished as mysteriously as the first!

---

[7] Forest & Stream, June 1, 1907, p. 854.

[8] Journ. Mamm., Feb., 1921, p. 26.

"This was a severe blow to Mr. Hunter's peace of mind; but he pulled himself together, and examined the camp thoroughly to see if some practical joker was not concealed about the premises. Finding no traces of anything in human form, he placed his third and last candle on the table, stood his axe within easy reach, and awaited developments. In a few minutes, a Flying-squirrel hopped in the door, boldly mounted the table, and knocked down the candle, thus extinguishing the flame. He started for the door with his booty when Mr. Hunter took a hand, and put the little rascal to flight."[9]

Home and Young Ones

The usual nesting place is a deserted woodpecker hole, but any hollow tree will serve. So far as recorded, the Northern Flying-squirrel does not make a dray or outside nest.

These industrious little creatures are said to produce three broods in a season.

The broods number from 3 to 6; and the first is born about the last of April. A female Flying-squirrel taken at Winnipeg by E. W. Darbey, on April 21st, contained 6 young ready for birth. The young found in a nest May 15th, were each 4¼ inches long, with tail 1½ inches; eyes not opened. They were probably three weeks or a month old.

Merriam says: "They breed about a month later than their smaller relative. June 18, 1883, Dr. A. K. Fisher and the writer found the nest of a Northern Flying-squirrel at West Pond near Big Moose Lake. It was in the last year's nest of a three-toed woodpecker (*Picoides arcticus*) in a tamarack (*Larix americana*); and the entrance hole faced the east, about 10 feet above the ground. On cutting down the tree, the nest was found to contain three nursing young, not yet one-third grown; they were estimated to be about a month old. They were fed on condensed milk diluted with water, until we left the woods, and afterward on fresh milk and vegetables. One of them grew very rapidly, attaining nearly two-thirds the size of his parents by the 10th of July, when it was accidently killed. They were all perfectly tame, and acted much like the young of the common Flying-squirrel."[10]

The devotion of the Flying-squirrel mother is touchingly set forth by Bachman[11] in his account of a family of this species.

"This brood was procured as follows: A piece of partially cleared wood having been set on fire, the labourers saw the Flying-squirrel start from a hollow stump with a young one in her mouth; and watched the place where she deposited it, in another stump at a little distance. The mother returned to her nest and took away another and another in succession, until all were removed; when the woodcutters went to the abode now occupied by the affectionate animal, and caught *her*, already *singed* by the fire, and her five young unscathed."

---

[9] Forest & Stream, April 3, 1897, p. 265.

[10] Mamm. Adir., p. 207.

[11] Q. N. A., III, p. 204.

These, with their mother, were kept in confinement about 4 months, and carefully observed. Nursing was performed thus: "The younglings stood on the ground floor of the cage, whilst the mother hung her body downwards, and secured herself from falling by clinging to the perch immediately above her head by her forefeet. This was observed every day, and some days as frequently as 8 or 10 times. [Nevertheless, we must not suppose that this is the normal attitude of all Canadian Flying-Squirrels while nursing.]

"After some time, a pair of the young were given away to a friend. The three remaining ones, as well as the mother, were killed in the following manner:

"The cage containing them was hung near the window; and one night, during the darkness, a Rat or Rats (*Mus decumanus*) caught hold of the three young through the bars, and ate off all their flesh, leaving the skins almost entire, and the heads remaining inside the bars. The mother had had her thigh broken, and her flesh eaten from the bone; and yet this good parent was so affectionately attached to her brood that, when she was found in this pitiable condition in the morning, she was clinging to her offspring, and trying to nurse them as if they had still been alive."

KINDLINESS

On one point, all observers are agreed—that is, the mildness and kindliness of this little cannibal.

Thus, Soper says of his trapping days in Wellington Co., Ont.: "When a boy on the farm in that region, I secured many in harmless box-traps, and kept them as pets in spacious cages, both winter and summer. They are sweet-tempered, docile little creatures, and bear repeated handling without sign of resentment."[12]

HIS WAY OF LIFE

The hardiness of this merry night-prowler is such that, although it ranges northwest as far as the Arctic Circle, it is not known to hibernate at any time. As Merriam says:

The Northern Flying-squirrel is a hardier animal than its smaller relative, and remains awake and active during the whole of our long and severe winters. The mercury may indicate a temperature many degrees below zero, or snow may be falling in quantities sufficient to obstruct the vision, without seeming in any way to dishearten this merry adventurer. The last rays of the departing sun have scarcely disappeared from the western horizon, before the sombre shades that mark the approach of winter night commence to gather about the snow-clad forest. Whether bright stars sparkle and shine through a frosty atmosphere, or heavy, leaden clouds overhang the scene, makes little difference to the Northern Flying-squirrel. He emerges from his warm nest, takes a hasty survey of the surroundings, lest some wily owl should lurk hard by, glides silently to a neighbouring tree, and starts forthwith upon his nightly tour in quest of food and sport.

---

[12] Journ. Mamm., Nov., 1923, p. 249.

"Prompted either by hunger or curiosity, or by a combination of the two, he examines every unusual object with scrupulous care; and, as one result, is always getting into traps set for valuable fur—and this whether they are baited with mammal, bird, or fish. Indeed, the nature of the bait seems to be a matter of the most trivial consequence, as it often consists of Red and Flying-squirrels that have previously been taken in the trap. Even in this case, another Flying-squirrel is as likely to be the next thing caught as any animal in the Wilderness. Hence it happens that the trapper comes to look upon him as an unmitigated nuisance."[13]

References

1849—Quadrupeds of North America, by Audubon and Bachman, III, pp. 202–05; 1 plate.
1884—Mammals of the Adirondacks, by C. Hart Merriam, pp. 206–08.
1918—Revision of the American Flying-squirrels, by Arthur H. Howell, N. A. F. 44, pp. 29–58; many ills.

---

[13] Mamm. Adir., pp. 206–07.

LIFE LXXXIII—POCKET-GOPHER

PAGE
Names 396
Species 396
Description: Size, Colour 397
Races 397
Range and Haunts 398
Home Range 400
Numbers 400
Solitary and Uncommunicative 401
Young 401
Food and Storage 401
Habits 402
Chiefly Nocturnal 404
Enemies and Parasites 405
Burrows and Dens 407
Dung and Mud Pellets 407
His Ventilator 408
Shafts and Tunnels 408
Industry 410
Snow Tunnels 410
Never Hibernates 412
Earthworms Unknown 412
Gophers Make the Loam 412
Number of Mounds and Size 414
Magnitude of His Work 417

Northern Pocket-gopher, Gray-gopher, Mole-gopher, Mole, Pocket-mouse, Canada Sand-rat, or Gaufre[1]

Thomomys talpoides (Richardson)

(Gr. *thomos*, a heap; *Mys*, a Mouse; L. *Talpa*, a Mole; and Gr. *eidos*, appearance, latinized into *oides*)

Cricetus talpoides RICHARDSON, 1828, Zool. Journ., III, p. 518.
Thomomys talpoides BAIRD, 1857, Mamm. N. A., p. 403.

TYPE LOCALITY—Carlton House, Sask.

FRENCH CANADIAN, *le Gaufre gris*.
CREE (?) *Ootaw-chee-gaeshees'* (Richardson, F. B. A., I, p. 204).
OJIBWAY, *Po-tach-i-ping-gu-a-shi*, i. e., "blowing up the soil."
YANKTON SIOUX, *Mah-hee-ah-chá*.
OGALLALA SIOUX, *Wah-hin-hay'-yah*.

Gopher is from the French *Gaufre*, a honeycomb, given because this creature honeycombs the ground.

The Family *Geomyidæ* are rodents about the size of a Rat; they live the life of a Mole, digging and dwelling in underground galleries; their fur is soft and fine, but dull gray or brown, without conspicuous markings; their eyes and ears are very small; their front feet are enormously developed for digging, their thumb is a mere knob with a nail; their tails are short, nearly naked, and, as Dr. C. H. Merriam points out, are developed as organs of touch, very serviceable when running backward in the burrow; in each cheek is an enormous fur-lined pocket or pouch, that opens in front outside of the mouth.

There are two genera represented in America north of the Mexican Boundary: *Thomomys* and *Geomys*, distinguished chiefly by the fact that the former has smooth incisors, the latter has them deeply grooved.

The genus *Thomomys* (Wied., 1839) answers to the foregoing, and has also the front upper teeth *without* a central groove. The dentition is:

$$\text{Inc. } \frac{1-1}{1-1}\text{; prem. } \frac{1-1}{1-1}\text{; mol. } \frac{3-3}{3-3} = 20$$

---

[1] This life was read in the present form before the Biological Society of Washington, and published in my Life Histories. In a condensed form, it appeared in the Century Magazine for June, 1904.

Some 94 forms (races and species) of *Thomomys* have been described—a wonderful illustration of the quick response to environment when the species is strictly localized in its life. These are grouped as follows, and in this case, "group" probably means "species."

talpoides	group, 12 forms	*umbrinus*	group, 8 forms
townsendii	" 2 "	*fossor*	" 5 "
bottæ	" 18 "	*douglasii*	" 8 "
alpinus	" 5 "	*monticola*	" 5 "
perpallidus	" 15 "	*fuscus*	" 5 "
fulvus	" 9 "	*bulbivorus*	" 1 "

The first of these, the Gray Pocket-gopher, is the one with which I am best acquainted. It will, therefore, be taken as the representative of all; for their habits are much alike.

In addition to the Family and generic characters, the Gray Pocket-gopher has the tail less than half the length of the head and body; the female has 6 pairs of teats, 2 under the fore legs, 2 on the chest, and 2 on the lower belly. The species has also marked peculiarities of size and colour.

Size. This is one of the largest members of the genus. A male taken at Carberry, Man., Oct. 31, 1886, measured total length from snout to tail tip, $9\frac{5}{8}$ in. (244 mm.); head and body, 7 in. (178 mm.); tail, $2\frac{7}{8}$ in. (73 mm.). The hind foot is about $1\frac{1}{4}$ in. (32 mm.).

The females are smaller.

Colour. The colour is a dark grayish, becoming browner on the back, and pale slaty below; nearly white on chin, throat, feet, and tail. It is difficult to describe the colour exactly, especially as there is a good deal of individual variation; but *talpoides* may be distinguished from its nearest neighbours by its greater size and darker colours.

All that I have seen had the back varied with cracks in the fur, i. e., cross marks where the dark underfur showed through.

RACES

The following forms have been listed for the *talpoides* group:

talpoides Richardson, the typical Gray Gopher, T. l., Carlton House, Sask.

rufescens Wied, a reddish form. T. l., Old Fort Clark, Mercer Co., N. D.

clusius Coues, a very small and pale form. T. l., Bridger Pass, Carbon Co., Wyo.

bullatus Bailey, size like *talpoides;* colour practically like *clusius.* T. l., Powderville, Custer Co., Mont.

nebulosus Bailey, like *talpoides,* but more brownish gray. T. l., Sundance, Crook Co., Wyo.

caryi Bailey, like *clusius,* but darker, more rufescent, without gray cheeks and sides. T. l., Bighorn Mts., Wyo.

pryori Bailey, size of *clusius,* but darker coloured, and with shorter nasals and more projecting incisors. T. l., Pryor Mts., Carbon Co., Mont.

agrestis Merriam, larger and paler than *clusius;* more like *bullatus,* but narrower skull, and larger, more pointed nasals. T. l., Medano Ranch, San Luis Valley, Colo.

columbianus Bailey, slightly smaller than *talpoides;* and colours paler. T. l., Touchet, Walla Walla Co., Wash.

ocius Merriam, small and very pale, with slender skull; mammæ normally in 7 pairs. T. l., Old Fort Bridger, Uinta Co., Wyo.

idahoensis Merriam, very small; pale yellowish gray; skull light and smooth. T. l., Birch Creek, Fremont Co., Ida.

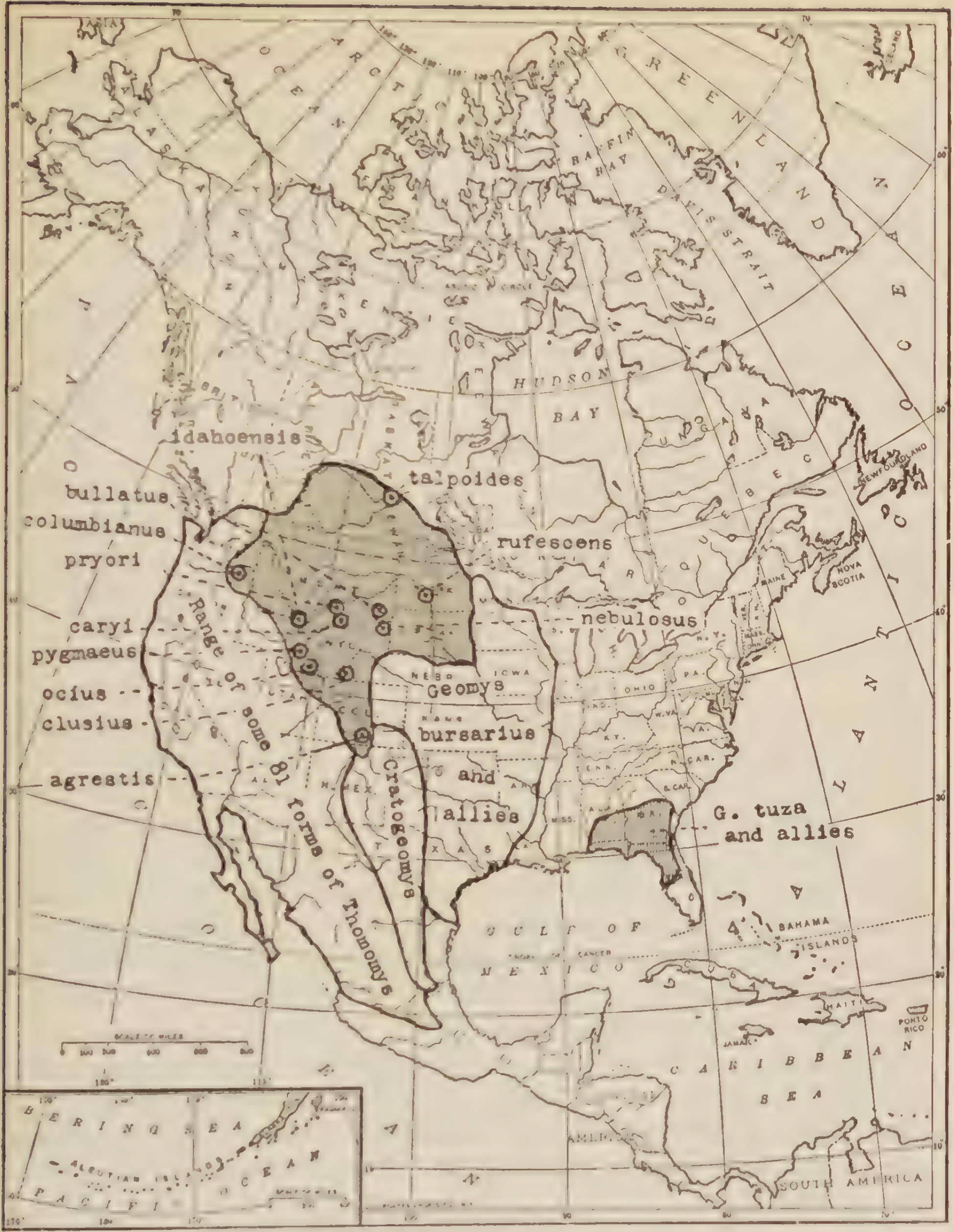
pygmaeus Merriam, smallest of all; colour, rich hazel brown; skull very slender. T. l., Montpelier, Bear Co., Ida.

RANGE AND HAUNTS

Map XII (p. 399) shows the range of the Family *Geomyidæ,* to which the Pocket-gopher belongs. The various species are found in the whole of the region west of the Mississippi Valley, as far as the Pacific Coast; south well into Mexico, and north at least as far as the Saskatchewan. Thus, they are found throughout a region of about 2,000,000 square miles.

Tht present is the only one inhabiting Manitoba. It abounds in the southwestern section of the Province, that is, all the prairie region except the low, wet part of the Red River Valley.

The members of this group find congenial surroundings on level prairies, low bottomlands, high uplands, and among sandy dunes. They abound on the plains and lowlands of Dakota, Minnesota, Wyoming, and Montana, as well as in all the aspen forests. On the Yellowstone, I found them even on the tops of the high mountains; for example, Mount Sepulchre (nearly 9,000 feet). All through the Clearwater region on the Bitterroot Mountains in Idaho, they are numerous, from the highest levels to the lowest flats, wherever there is soil enough to dig in. On the White River Plateau of the Colorado, at least one species is plentiful, from the uppermost peaks to the lowest slopes of the quaking aspens. In California, they exist in vast numbers



MAP XII.—RANGE OF THE POCKET-GOPHERS

By E. T. Seton, with assistance of the Biological Survey, 1927

from sea level at San Francisco to above timberline on the High Sierra, in all situations where there is soil enough or even gravel enough to afford them cover. I even found that an old dead crater, near Mount Tallac and almost as high, was the scene of unnumbered eruptions of Pocket-gopher origin.

There are, doubtless, large arid or annually flooded areas that they do not inhabit; but, it may be stated in general, that they are to be seen in every part of the great West where there is soil enough to burrow in, and rain enough to produce a crop of annual plants.

In Manitoba, *talpoides* finds its choicest homelands on the rich, rolling, open country of the Assiniboine, and rarely ventures far into the woods.

Home Range

Its home range is quite certainly limited to the quarter acre over which its mounds are seen. It does not, so far as known, migrate in the slightest degree. Therefore, it is the most localized of all the mammals on this list—a residential fixity that has had the usual result of developing numerous races.

Numbers

On all the prairies of western Manitoba, this species is in maximum numbers. After walking over much of the region, and estimating by results the numbers of Gophers, I set the population at 5 to 10 per acre. The estimate is sustained by the following facts supplied me by Louis J. Ohnimus, Superintendent of the Golden Gate Park, San Francisco. In that famous park, one species of *Thomomys* (*T. bottæ*) is common and very troublesome. Ohnimus wrote me in 1899 as follows: "From 100 to 300 Gophers are killed every year in the Park. About 100 to 150 acres are covered in the killing. The trapping is generally carried on for three or four months of each year. The Gophers are decreasing in number under this drain."

From this, it might be inferred that 2 or 3 Pocket-gophers to the acre was the probable population; but I examined the area in question, and it showed so little Gopher work that evidently the trapping had been succeeding for some time, and the Gopher population was very far below the average.

In the Golden Gate Park, they merely injure the lawns and gardens by throwing up lines of hills overnight, but I have seen vast areas in the Sierra, Colorado, Wyoming, Dakota, and Manitoba, where walking was most laborious, on account of the number and extreme activity of the Gophers—where, indeed, a man sank several inches and a Horse nearly a foot at each step. I should think, therefore, that 5 to 10 Gophers per acre was well within their numbers where they abound.

But they do not abound in all parts of the range; therefore, I should take a fifth of the lowest figure for an estimate, and allow for this range of 2,000,000 square miles a total Gopher population of 1,000,000,000. *Talpoides* is found in about one-tenth of this range, and therefore should be represented by 100,000,000 individuals. Probably its numbers do not fall far below this.

SOLITARY AND UNCOMMUNICATIVE

The *talpoides* seems to be a solitary animal. I usually found that, after trapping one, the mound upheaval ceased in that tunnel for a time. An exception to this was observable in late May and early June, when I commonly got two—a male and a female—before the signs of activity ceased in that particular labyrinth.

Being neither sociable nor gregarious, the Gopher has not developed many methods of intercommunication. Ordinarily, it is silent. When taken alive, it hisses, grinds its teeth, and sometimes utters a low snarling.

YOUNG

I have never seen the nest of *talpoides*, but I took 5 well-developed unborn young from a female on June 29, 1892. They were certainly within two weeks of birth. A female taken alive August 1st, was evidently nursing. On Sept. 8, 1884, I captured 2 half-grown young, and saw others that month.

Louis J. Ohnimus informs me that *bottæ*, which abounds in Golden Gate Park, breeds in the fall and winter, and has 5 to 6 in the litter. In the autumn, the young apparently scatter, and each begins its solitary life by burrowing for itself. At this time, the size of the Gopher may be fairly estimated by the calibre of its tunnel and by the number of mounds it throws up.

FOOD AND STORAGE

The food of the Pocket-gopher is chiefly, if not exclusively, vegetable; roots, grain, grass, and the leaves of various plants are staples.

In Manitoba, during the spring of the year, I have several times ploughed out its storehouses, and found the grain in them—amounting to 3 or 4 pints—not mixed, but each kind in a separate pile.

In Minnesota, Herrick says:[2] "The main runway was provided with blind alleys at intervals, each of which was somewhat expanded at the end. Here a store of grass roots is accumulated in quantities varying from a pint to nearly half a peck. The amount seems to be intentionally limited, so that the slight heating shall stimulate the roots to fresh growth, thus providing fresh supplies for the winter. Larger chambers are constructed for the tubers of Helianthus, etc."

---

[2] Mamm. Minn., 1892, p. 229.

In Colorado, I dug out a food store of the *fossor* species. The plants in it were cut in sections about 2 inches long—that is, to fit the cheek-pouches of the animal—and stowed on the outside of the bed-lining. This food consisted chiefly of the leaves and hollow stems of a large composite plant, a specimen of which is shown in Plate XLVII (p. 411). It was very abundant at this time (September) in all the hollows, but not immediately over the nest. Evidently, the Gopher had gone abroad to gather this food.

I have several times found roots in the pouches of the Gopher; one purpose of its burrowing, indeed, is to get a choice variety of these. I personally have never known it to destroy root crops, though I have heard of such things elsewhere.

My captive specimens always refused drink.

HABITS

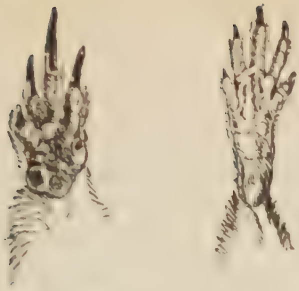
The Gopher leads the life of a Mole, living in a burrow which is about 3 inches wide, and ramified indefinitely near the surface. It throws up a mound every few feet; but, in some cases, a gallery is run for 20 or 30 feet without a mound appearing.

Its method of burrowing, as observed in captive specimens, is to loosen the earth with the powerful front claws, as it stands with hind feet advanced and widespread; then throw it backward between the hind legs, to be further passed on by the hind feet. When a sufficient pile is ready, the Gopher turns around, and pushes with its broad head and sturdy front feet, forcing the pile ahead of it to the first side gallery, up that and out, usually without exposing itself.

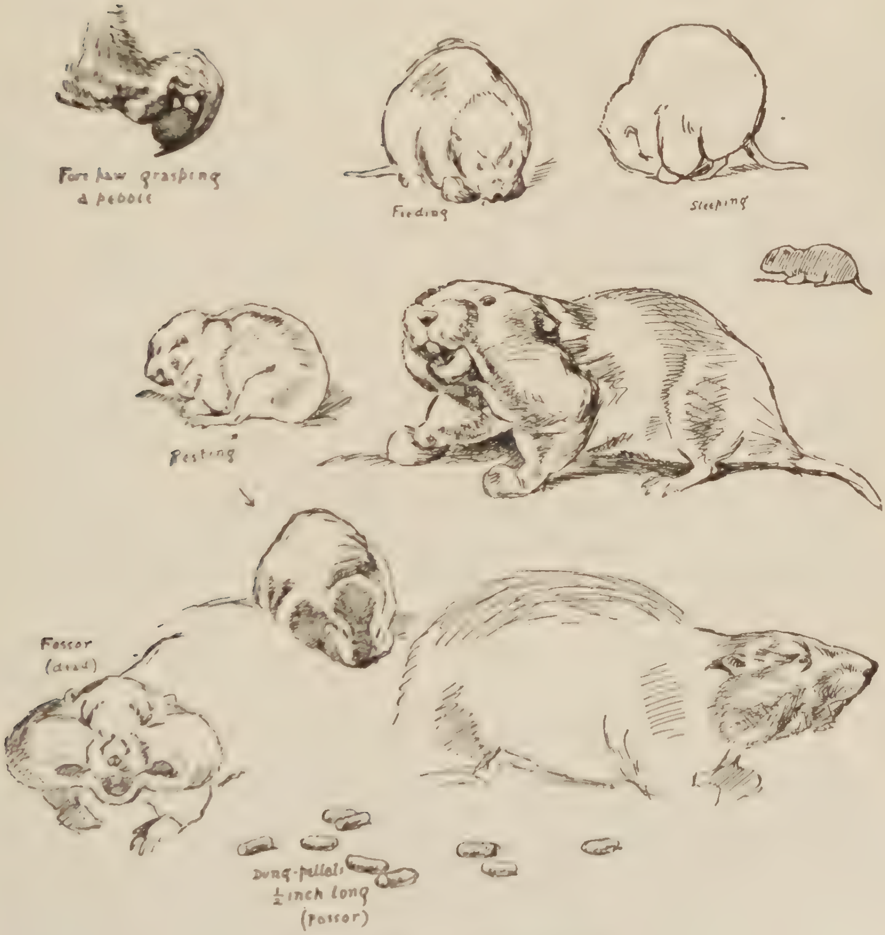
The earth is always moved thus, *not in the enormous cheek-pouches*, as some believe. In all my experience, I have never known these to serve for anything but provender bags. In one or two cases, I have found a little earth in the pouches, but obviously it came from some roots that the creature was carrying home.

In Aug., 1892, I caught a Gopher, and kept it captive for some days, while I sketched the attitudes that appear in Plate XLIV, (p. 403) I also got some new notes on its habits.

On being offered grass, it was careful to cram its cheek-pouches before eating. To make this easy, it cut the grass in lengths with its teeth, then



Right fore paw and hind foot of *T. fossor*, life size. Colo., Sept. 10, 1901. E. T. S.



Life studies of *Thomomys talpoides*

PLATE XLIV.—LIFE STUDIES OF POCKET-GOPHER transferred the pieces to the pouches by the use of both paws, as well as teeth and lips. In doing this, its movements were so quick as to make observation difficult.

One of the most curious characteristics of its forepaws is their perfect prehensileness. This is attained, not by a true digital prehensility, but by the long claws working against the large pad or cushion of the pisiform region as is the case with the Sloth and some other animals. This power seems of use only in the handling of food, while foraging, eating, or filling the pouches. The animal seemed as incapable of climbing as a Dog or a Sheep.

My notes on another captive are thus recorded:

Carberry, Man., July 29, 1892. In the morning, I investigated a Pocket-gopher's labyrinth. The part that I opened is shown in Plate XLV (p. 406). This was about 9 inches below the surface; and each gallery about 3 inches in diameter. It was continued northwest for about 50 feet farther, with fresh mounds at various points all along. I set the trap in a hole near the north end, and in the evening found the Gopher caught by the hind leg. It was not vicious, and when taken out and put on the ground, it made but little effort to escape, either by digging or by running. It refused water, but ate grass readily. Its fur showed the usual two or three cracks across the back. Its movements were rather slow.

When walking, its fore feet rested on the outer edge with the claws turned inward, in the manner of the great Ant-eater.

July 30, 1892. In the evening, I noticed that the Pocket-gophers begin work at 6 P. M., that is, as soon as the heat of the day is over. My second captive specimen is apparently thriving in its box.

Aug. 1, 1892. This morning, after 4 days captivity, the Pocket-gopher died. The labyrinth in which I caught it, and which I had partly opened, showed fresh hills to-day. I therefore dug open about 20 feet more, but discovered neither nest nor another occupant. The captive may have been preparing for a family, for it gathered into one corner all available material for making a bed.

Chiefly Nocturnal

Most of the Gophers rest while the sun is high. In Colorado, I have heard *fossor* digging under my bed in camp at night and in the early morning. Fresh mounds are found at dawn over the tunnels of all the species I have observed, namely, *talpoides*, *fossor*, *monticola*, and *bottæ*.

Of course, it matters little to this child of the dark world whether the other world be bright or not when he works; and yet there is little doubt that, at night, his upheavals are less likely to catch the eyes of watchful foes.

This does not mean that the Gopher never toils by day. Early morning and late evening are favourite times with *talpoides* in Manitoba. Indeed, it is always ready to work except in the hours of extreme heat; and I have known a continued temperature of 90 degrees in the shade to stop all upheavals for some days.

Frequently—possibly every night—the Gopher quits the burrow and sallies forth into the open air, foraging for grain and foods not obtainable underground. These it crams hastily into its pouches, then retires to its burrow to consume them. The cover of night is essential to these expeditions; they are seldom made in broad daylight, though they may be undertaken in twilight or by the light of the moon.

In Fisher's report on "Food of Hawks and Owls, 1893," I find 12 cases cited in which hawks had preyed on Pocket-gophers, and only 8 in which owls had done so. But there were a vast number of hawk observations, and comparatively few for the owls; so nothing is settled by this. I personally have never taken a Gopher from a hawk, but have known the horned owl, which is a night feeder, to capture many of them. So, also on May 5, 1887, my friend, Miller Christy, wrote me from Western Manitoba. "To-day, I found a nest of horned owls in a poplar tree on the open prairie. Besides the two fledgling birds, it contained the remains of 20 Pocket-gophers in various stages of decay."

In California, the food of the barn-owl, according to Clark P. Streator,[3] is almost exclusively Pocket-gophers the whole year round. As the barn-owl is nocturnal in its feeding habits, this is good evidence that the Californian Gopher also is a nocturnal species.

There is one time when the Gopher is very apt to become the prey of day-feeders; that is at noon, when, as later described, the digger opens its burrow to let in the sun, and may thus be surprised by a watchful foe.

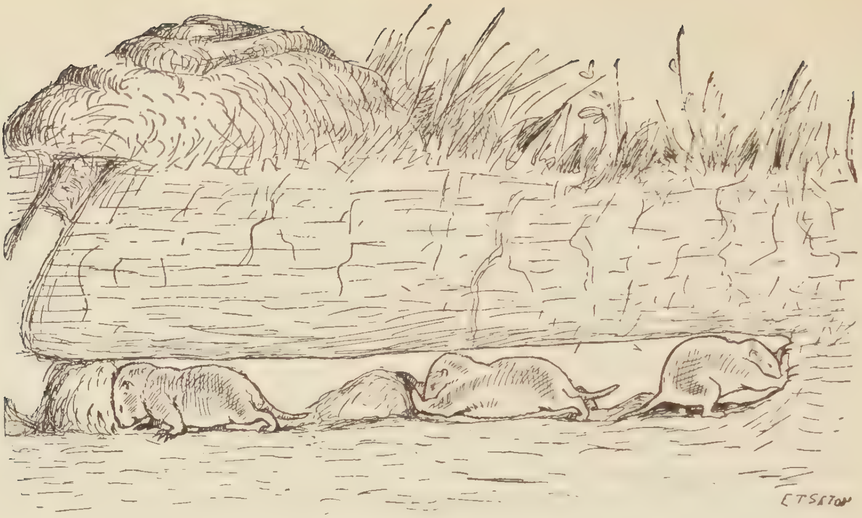
ENEMIES AND PARASITES

Obviously, the chief enemies of the Pocket-gopher are owls; but we must add to these, hawks, Badgers, Weasels, Coyotes, Foxes; and in some regions, snakes, which enter the tunnels if they chance to find them open. The care with which the Gopher will plug the burrow as often as one exposes an entrance, is probably an instinctive precaution against such marauders. If the burrow be persistently opened for two or three days, the Gopher abandons it.

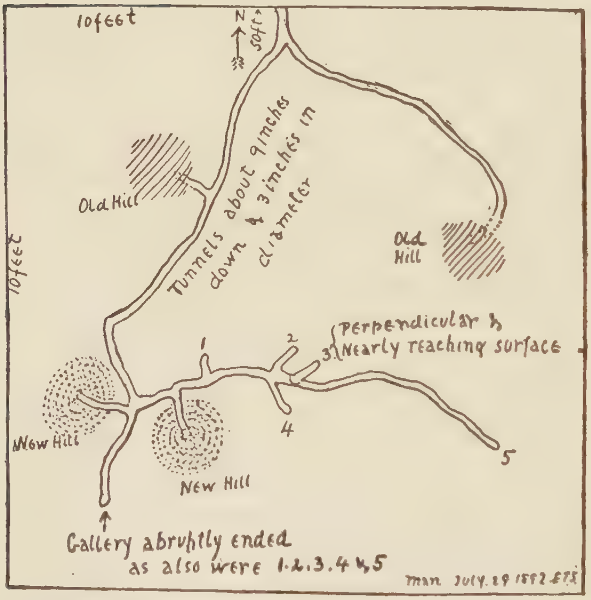
I have seen patches of 50 to 100 square yards on the damp creek bottom

---

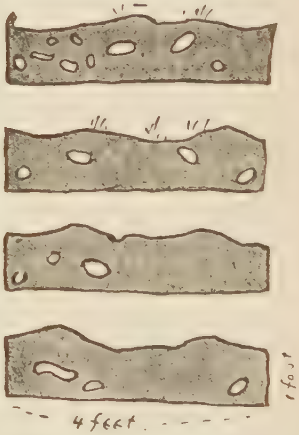
[3] See Fisher's Report, p. 134.



Attitudes in burrowing; the same animal in different poses


10 feet
N
soft
Tunnels about 9 inches down & 3 inches in diameter
Old Hill
Old Hill
10 feet
1
2
3
Perpendicular & Nearly reaching surface
4
5
New Hill
New Hill
Gallery abruptly ended as also were 1.2.3.4 & 5
Man July 29 1882 ETS

Burrow of *T. talpoides;* about 30 feet are shown; it was continued at least 50 feet farther, with many mounds



Prairie sections made at Carberry, Man., in 1882, to illustrate the number of Gopher burrows near the surface. Most of these were plugged with lighter coloured subsoil

PLATE XLV.—BURROWS, ETC., OF GOPHER

that had plenty of old, but no recent, signs of Gopher work. These I could not account for, unless it was that Weasels had killed off their mining population.

In Manitoba and New Mexico, I have several times found Gophers with an interesting kind of companion or semi-parasite. Amphibians of the genus *Amblystoma* commonly take refuge for the winter in the Gopher tunnels.

The common toad, also, will avail himself of the easy digging furnished by the new Gopher mound, when the time comes to bury himself for the season.

BURROWS AND DENS

The burrows of this famous burrower are of two kinds—forage and residential. I have never investigated fully one of the latter made by the Manitoba species, but have opened many of its forage burrows. These are usually 2 to 3 inches in diameter, and 4 to 8 inches from the surfaces. Plates XLV (p. 406) and XLVIII (p. 415) show typical examples.

But in Colorado, on the White River Plateau, in Sept., 1901, I spent three days investigating the complicated home of an allied species, *T. fossor*. The notes in my journal run thus:

Pagoda Peak, Colo., Sept. 9, 1901. In the afternoon, we dug out the labyrinth of a Pocket-gopher. The species abounds in every part of the country we passed through. It keeps the ground soft even at 10,000 feet elevation.

The burrow was on a slope with an eastern exposure. We dug out 125 feet of it, most being about 4 inches from the surface in the friable soil; but near the nest, it dipped down through hardpan vertically 24 inches from the surface, as shown in Plate XLVI (p. 409).

The central chamber had a 3-inch lining of finely chewed grass; it was 12 inches long, 9 wide, and 7 high; and perfectly clean.

DUNG AND MUD PELLETS

Special places, or pockets, were provided for the dung. There were great quantities of this—fully three pints—some of it being very old and mouldy. At only one place did we find any of it in the main gallery.

The form taken by dung pellets is, of course, regulated by the intestine, and shows the affinities of the animal. The dung of Rabbits is round, of Mice and Squirrels double-conical or oval, that of the present species, cylindrical. (See Plate of Scatology, LXXVIII, p. 631.)

At several places were piles of earth pellets, a gill or so in each. These were compact and rounded, of various sizes, and looked like worm castings.

Some were of black mould, some of yellow clay, the two kinds being in separate piles. The only explanation that I can suggest for these is that, in going out to forage during wet weather, the animal's fur becomes soiled, and the mud is afterwards cleaned off and accidentally rolled into these pellets before the Gopher re-enters the nest—another indication of its cleanliness.

This animal, in common with all that construct elaborate homes, has made good progress in sanitation.

His Ventilator.

A common habit observed in *talpoides*, *fossor*, and *monticola* is, as mentioned already, that of leaving the burrow open an hour or two on sunny mornings, apparently for air or sunlight. Possibly the Gopher lies below the open hole to enjoy the warmth. No doubt, the passing of the miner along the snug-fitting tunnel while one door is open, draws in fresh air enough to last for some time.

He plugs the ventilator up again about noon. This general move to close the air-hole gives the appearance of a midday period of activity at tunnelling.

On Sept. 10th, I caught a female Pocket-gopher in a burrow connected with the above, and continued the examination and measuring of the galleries.

On Sept. 11th, we proceeded with our investigations, but saw nothing of the owner; so either it escaped by one of the side galleries, or it was the female caught yesterday. This morning, however, fresh hills appeared near the trench we opened.

There were no mounds near the chamber or its galleries. The few marked on the plan were new ones, but the whole surface bore evidence of having been disturbed early this season. In the spring, no doubt, the plot was dotted with numerous hills, since levelled by the weather, etc.

This investigation kept two of us hard at work for nearly three days with shovels, rule, and tape-line.

No doubt, the residential burrows of *talpoides* will be found much like this.

Shafts and Tunnels

There is yet one other type of burrow that I attribute to *talpoides*. The only one of these which I investigated was while digging a well on the Big Plain in Manitoba in 1882. It went down spirally for 15 feet, then it left the line of the well. Old residents told me that such were commonly found, and were understood to be made by the Pocket-gopher seeking water.

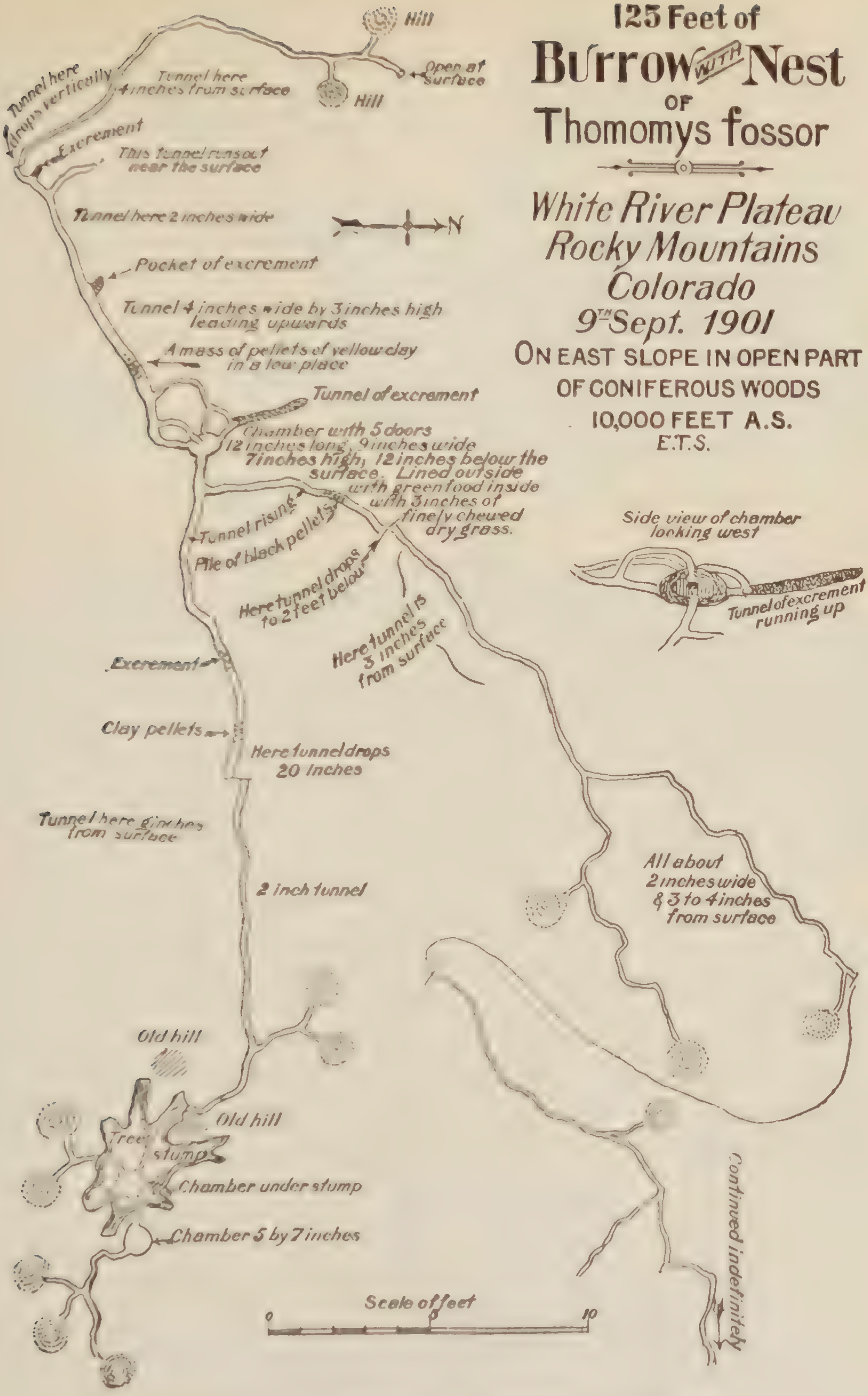

125 Feet of
Burrow with Nest
of
Thomomys fossor
White River Plateau
Rocky Mountains
Colorado
9th Sept. 1901
On east slope in open part
of coniferous woods
10,000 feet A.S.
E.T.S.
Hill
Open at surface
Hill
Tunnel here drops vertically
Tunnel here 4 inches from surface
Excrement
This tunnel runs out near the surface
Tunnel here 2 inches wide
N
Pocket of excrement
Tunnel 4 inches wide by 3 inches high leading upwards
A mass of pellets of yellow clay in a low place
Tunnel of excrement
Chamber with 5 doors 12 inches long, 9 inches wide 7 inches high, 12 inches below the surface. Lined outside with green food inside with 3 inches of finely chewed dry grass.
Tunnel rising
Pile of black pellets
Here tunnel drops to 2 feet below
Here tunnel is 3 inches from surface
Side view of chamber looking west
Tunnel of excrement running up
Excrement
Clay pellets
Here tunnel drops 20 inches
Tunnel here 8 inches from surface
2 inch tunnel
All about 2 inches wide & 3 to 4 inches from surface
Old hill
Old hill
Tree stump
Chamber under stump
Chamber 5 by 7 inches
Continued indefinitely
Scale of feet
0
5
10

PLATE XLVI.—RESIDENTIAL BURROW OF GOPHER

I did not see the animal that made it, and do not believe that Gophers seek water; but the tunnel was of the same size as those made by *talpoides*, and the only other possible makers were the Citelli (*richardsoni* and *tridecemlineatus*).

Whatever the explanation of the deep shafts, they are not as important as the ordinary tunnels. These are 4 to 10 inches down, and about 3 inches wide, as illustrated in the sections made in Manitoba, 1882. Plate XLV (p.406). These tunnels are connected by frequent side galleries with the surface; and although along the cutbanks of the creeks in California, I saw a great many holes, apparently made by these rodents, down 3 or 4 feet, we must believe that the special realm of the Pocket-gopher's activity is—like the farmer's fortune—in the soil within a foot of the surface.

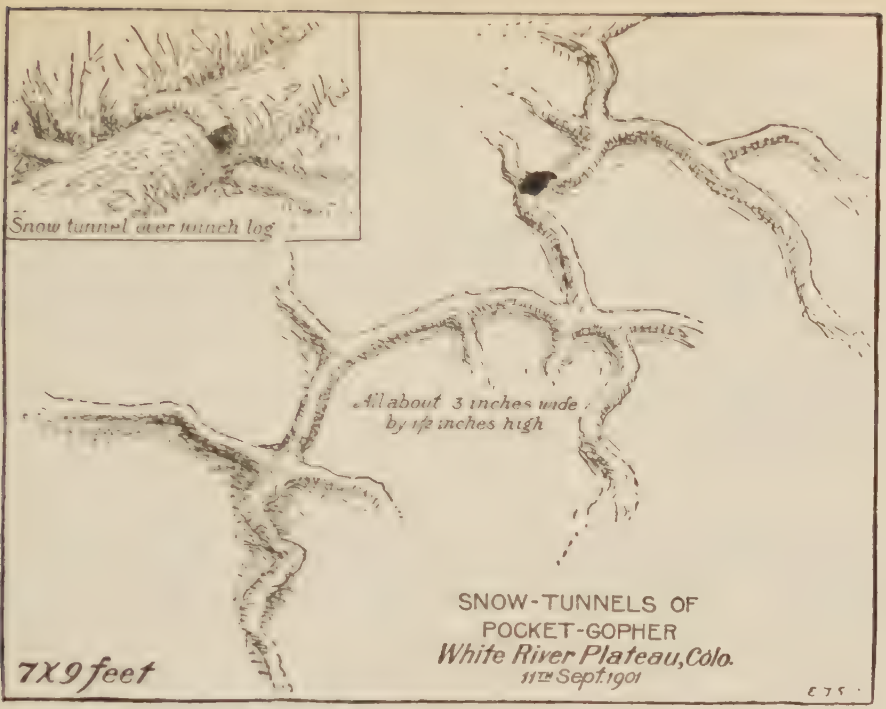
INDUSTRY

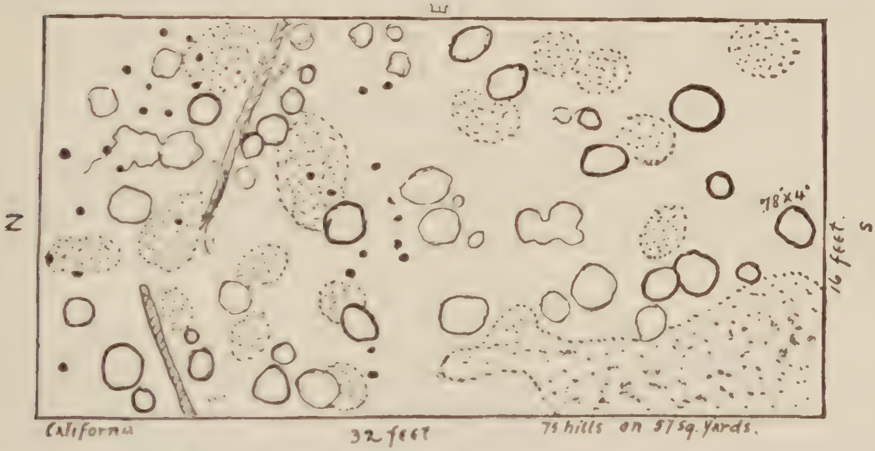
The Gray Pocket-gophers work morning, evening, and night not only in the summer; they are active during a larger part of the year than most burrowing rodents. Of course, that activity is varied with the season. I have many observations to show that *talpoides* is most energetic in the springtime. J. B. Goff assures me that this is true also of the Colorado species. Through the summer, the Gophers continue their work with little relaxation in the hottest weather; and in Manitoba, *talpoides* works away, pushing its great black mounds through the snow long after the frost of winter has stopped the plough.

SNOW TUNNELS

During the coldest weather, the Gopher never appears outside; and yet evidently continues its labours. We have proof of this in the remarkable clay castings or tunnel plugs that it leaves under the snow. In the spring, after the snow and ice have melted, these clay casts are found in curious serpentine labyrinths over the grass of the hollows. They are, no doubt, the material that would have formed hills, had the snow not compelled the Gopher to dispose of the stuff in a different way.

Plate XLVII (p. 411) shows a snow-tunnel plug by *fossor*. I saw hundreds of these in each day's ride through the mountains of Colorado; they were seen chiefly in upland hollows where the snow had been deep. This, though it had been exposed to the weather for five months, was 1½ inches high and about 3 inches wide. I imagine that, when first uncovered by the melting of the snow, it was at least 3 inches high. It is far from being an unusual one, and was drawn because it happened to be near my camp. During the day, I passed many that were larger and more complicated.





Work of *monticola*, near Lake Tahoe, Calif., Sept. 23, 1899

PLATE XLVII.—EARTHWORKS OF GOPHER

In a corner of the same drawing, is shown a curious case where the Gopher had carried his snow-tunnel and earth-plug over a log 10 inches in diameter.

NEVER HIBERNATES

It is clear that the Pocket-gophers do not hibernate. The species that I have observed, do not get fat in the fall; *fossor* and *talpoides*, I know, lay up a store of food for the winter; and as early as April 12 (1883) at Carberry, I took one from a white owl. Evidently it was abroad foraging, though there was yet plenty of snow on the ground.

There is every reason to believe that *talpoides* and its kin continue active the whole year round—which means that they never cease to dig.

EARTHWORMS UNKNOWN

In his well-known book on "The Formation of Vegetable Mould through the Action of Worms," Darwin begins with this statement: "Earthworms are distributed throughout the world," and later gives much detailed evidence in support of it. I was therefore greatly surprised, on going to Manitoba in 1882, to find that the common earthworm was there quite unknown.

I was not aware at the time that in 1828, Richardson wrote[4] of the Mole-gopher: "It cannot, like the English Mole, feed on earthworms, for none exist in those latitudes. . . . I was told by a gentleman who has for forty years superintended the cultivation of considerable pieces of ground on the banks of the Saskatchewan, that during the whole of that period, he never saw an earthworm turned up."

In Nov., 1882, I recorded the absence of earthworms from Manitoba in my paper on the Gophers, published by the Manitoba Department of Agriculture in the spring of 1883.[5] The following remarks appear therein:

GOPHERS MAKE THE LOAM

"Doubtless, all the hearers of this paper are familiar with the outlines of Darwin's theory that the worms are the makers of the black loam. Now, an earthworm is a creature altogether unknown in this part of the world . . . so the presence of from 10 to 20 inches of the best black loam would seem to stagger the worm theory. Perhaps the Gophers are a perfect substitute for worms."

In 1883, I was visited by Miller Christy; and together, we investigated a considerable section of Manitoba without finding any earthworms, and satisfied ourselves that they were not native to the region.

---

[4] F. B. A., I, p. 204.

[5] Agr. Rep. Man. for 1882, pub. Winnipeg, 1883, pp. 169–72.

The following year, Christy published in *Nature*[6] a paper "On the Absence of Earthworms from the Prairies of the Canadian Northwest," in which he gives many facts showing that earthworms are not native to Manitoba, and says:

"Further, Mr. Leo Rogers, son of Mr. Thomas Rogers, of Manchester, who has spent several years with the engineers of the Canadian Pacific Railway, has informed me that earthworms are unknown between Winnipeg and the Rockies."

In the Winnipeg reprint[7] of this article, the editor adds these remarks: "In *Nature* of Feb. 28, 1884, Mr. T. E. Wilcox, of Vancouver Barracks, Washington Territory, says: 'Miller Christy writes on the absence of earthworms from the prairies of the Northwest. I can confirm his statements, and extend them to cover the prairies of Kansas, the Indian Territory, and Idaho and Washington Territories. . . .

"'At Boise City, Idaho, some enthusiastic disciples of Izaak Walton imported and successfully reared the coveted bait in soil suited to the habitat of the *Lumbricidæ!*'

. . . .

"In *Nature*, March 27, 1884, Dr. Hy. F. Walker, of New York City, wrote in reference to Christy's paper, 'The observation there made is correct as to the absence of earthworms in the region mentioned.'

. . . .

"For years, I have been accustomed to go to Muskoka, in the Canadian Dominion, for shooting and fishing. This section is a wooded wilderness with numerous lakes and streams. It is still governmental wild land, and in part unsurveyed for settlement. The frontier settlers there tell me that, until a place has been inhabited for five years, it is useless to search for the earthworm."

Following my article a year later, Prof. Robert Bell, of the Canadian Geological Survey, read, before the Royal Society of Canada, on May 23, 1883, a paper called "The Causes of the Fertility of the Land in the Canadian Northwest Territories,"[8] in which are these paragraphs:

"As far as I am aware, earthworms are not found in the Northwest. If they exist at all, it will be in the woods, or in the older cultivated lands into which they have been introduced from abroad, as I have never seen them or heard of them in the unbroken prairie. . . .

---

[6] Jan. 3, 1884.

[7] Rep. Dep. Agr. Man. for 1883, pub. 1884, p. 349.

[8] Rep. Dep. Agr. Man. for 1883, pub. 1884, pp. 346, 348.

"The formation of the vegetable mould in these regions must, therefore, be due to some other agency than that of worms; and this I believe to be principally the Moles, which live in vast numbers throughout the region in question; and although apparently insignificant animals, accomplish more in the way of soil-making than the earthworms of England. . . .

"If the fertility of tens of millions of acres of land in the Northwest, and consequently their value, has been mainly due to the work of Moles, these apparently insignificant little creatures may be regarded as the most important of the native animals of the country."

Since 1882, I have made personal investigations in parts of Saskatchewan, Alberta, Southeastern British Columbia, Dakota, Wyoming, Montana, Idaho, Colorado, New Mexico, Arizona, and the mountains and dry parts of California; and made numberless inquiries covering the western part of the Mississippi drainage, as well as all the adjoining mountains, without hearing of any earthworms excepting in localities where they were introduced. (They have recently appeared in many highly cultivated parts of Manitoba.)

Further, I am satisfied that, excluding the narrow humid belt along the Pacific Coast, earthworms are not native to any part of America south of the Great Slave Lake, or west of the immediate Mississippi Valley. Probably the true earthworm is not native to any part of North America.

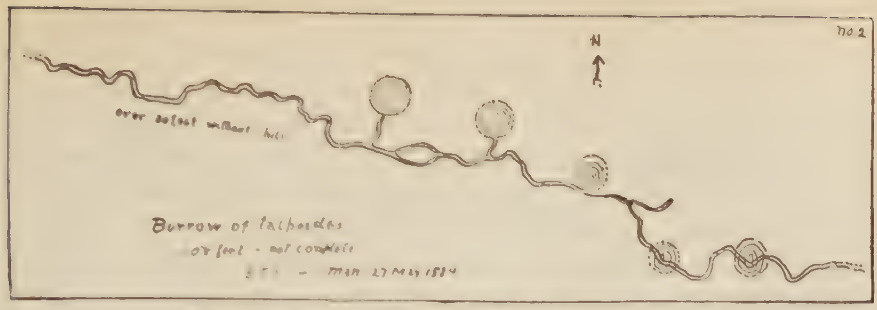
According to Darwin, there should be no vegetable mould in this vast continental region. There exists, nevertheless, a fine stratum of humus in all parts of it where there is moisture enough to produce annual vegetation. The black loam in Manitoba is from one foot to two feet thick—an amount probably not exceeded over any large area elsewhere in the world. This is not a solid bed of decayed vegetation, but is thoroughly mixed with the upper formation.

There is no doubt, then, that, in the absence of earthworms, this mixing is done, as already stated, by a number of species of burrowing animals, but by far the most important of these are the *Geomyidæ* or Pocket-gophers.

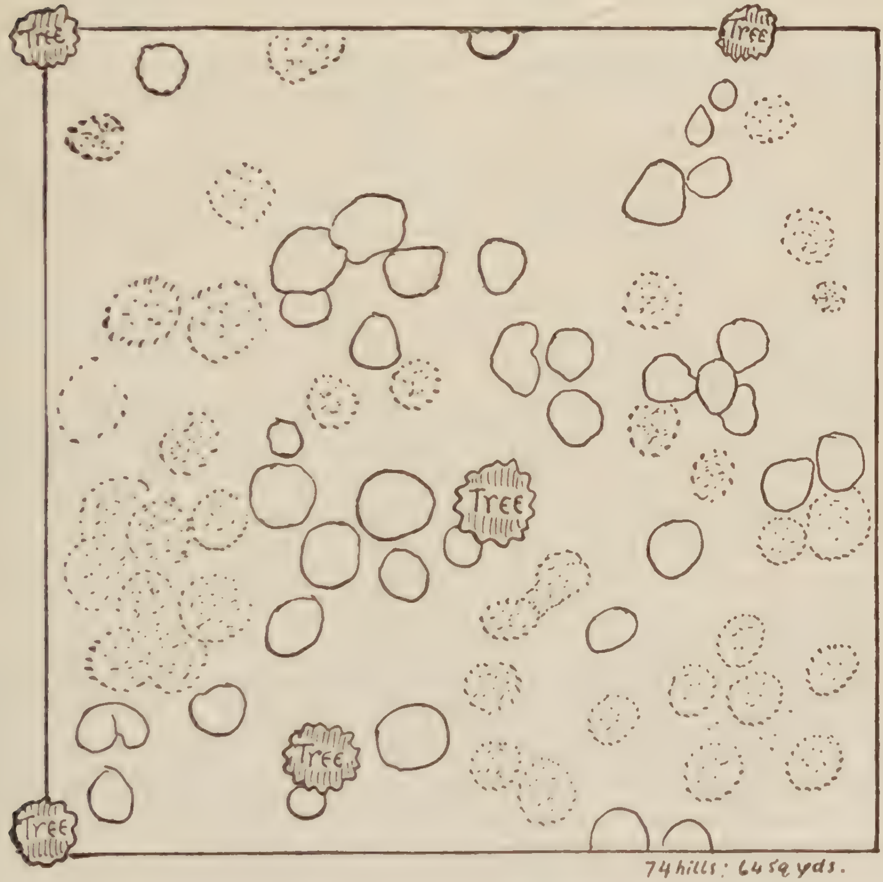
NUMBER OF MOUNDS AND SIZE

We have already noted the vastness of the area inhabited by the Pocket-gophers, their ubiquity in that area, the greatness of their numbers, and the assiduity of their labours. Let us now look at the results in detail, and, finally, in mass.

In Plate XLVII (p. 411) is shown the work of *T. monticola*, on a plot 16 x 32 feet, found on the west side of Lake Tahoe, in California, Sept. 23, 1899. In this, the black spots show where some animal had laid open the



Burrow of *talpoides*, Carberry, Man., May 27, 1884



74 hills: 64 sq yds.

Gopher work in Colorado, on a space 24 feet square, Sept. 16, 1901

PLATE XLVIII.—MOUNDS ETC., OF GOPHER

Gopher's burrow; but there was nothing to say whether it was done from above by some enemy, or from below by the Gopher itself. The dotted spaces represent very old hills, either of last spring or of the year before. Those faintly outlined are recent hills, and the heavy-lined hills were about a day old. A sample hill is seen in the middle of the right or south side. It was 18 inches wide, 4 inches high, and contained about a third of a bushel of earth. This is probably an average hill; but in Manitoba, I have seen others 10 inches high, and 4 to 5 feet across, thrown up from a single burrow, and containing 7 or 8 bushels of loam.

On April 29, 1904, at Whitewater, Man., E. W. Darbey and I staked off 20 yards square in the middle of a large Gopher tract, then carefully counted the hills—there were 78. We then measured in a bushel measure a number of the mounds, and found that an average one was a good half bushel, a large one 2 bushels. Altogether, they represented about 40 bushels of earth. All these had been made apparently that season.

In the Sierra, Sept. 23, 1899, I saw 10 large hills thrown up in one day from one tunnel; many extensive areas had had the surface wholly turned that year. I noted some, of course, with little Gopher work, but very few with none.

At Carberry, Man., Sept. 8, 1904, on a space 5 yards long and 1 yard wide, I counted 7 new mounds less than 24 hours old; an average one was 18 inches wide and 3 inches deep.

In another Sierra valley, Sept. 24, 1899, I saw 15 fair-sized hills thrown up within 24 hours, apparently by a single Gopher; and scattered with them were 32, so recent that only one inch of their exterior was dry. All were within a radius of 15 feet. The aggregate of these 47 hills thrown up in two days, was not less than 25 bushels of earth. At another camp in the Sierra, that same month, I examined many large areas which gave similar results.

An even better illustration I observed on the South William River of Colorado, Sept. 16, 1901. Under the shade of some scattering aspens where we were camped, I measured off a space 24 feet square, and carefully plotted the Gopher mounds on it (Plate XLVIII, p. 415). The firm outlines are around the hills that were less than a week old, the dotted lines mark hills about a month old, but the whole surface had evidently been turned this summer; the ground was so soft that the Horses sank 6 to 10 inches in walking across it.

This was a fair sample of the flats and hollows throughout the White River region, except where it was rock or very hard clay.

The California example (Plate XLVII, p. 411) shows that 75 hills on its area of 57 square yards; at this rate, there would be 6,000 hills to the acre. An average hill among these, was 18 inches across and 4 inches high, as nearly as possible one-third of a bushel; therefore 2,000 bushels per acre were upheaved within two or three months by the Pocket-gophers—enough to cover the whole area evenly to the depth of one inch.

In the Colorado example (Plate XLVIII, p. 415) with 74 hills to 64 square yards, the result appears slightly lower; but it should be remembered that, in this case, the hills over a month old were not counted, as heavy rains had melted them to a general level. Those remaining would, if levelled off, cover the ground to a depth of one-half an inch; this was one month's work for the Gophers.

In the other cases cited, 4 to 5 bushels were thrown up in one night by a single Gopher. In the second Sierra case, the 47 hills or 25 bushels thrown up, would equal 1,500 bushels per acre, or if levelled, about one-half inch over the entire surface in *two days*.

MAGNITUDE OF HIS WORK

From the sum of all these observations, I conclude that these animals completely plough the surface of the country, that is turn it all over at least once in two years.

As already seen, they are more or less active the year round; and even halving the lowest estimate of their numbers to cover sparsely populated regions, and again halving the estimate of their work to allow for periods of comparative idleness, we shall still have an even upheaval of between two and three inches per annum.

In Colorado, I made a number of observations that seem to more than justify this conclusion. For example:

Sept. 22, 1901. Camp on Wilson's Flat-top, Colo. Here, as elsewhere noted, the whole country is ploughed up by Pocket-gophers. Aspen logs[9] with the bark on, rot in three years, if set in the ground, and in five above ground; and yet I found here many fallen trunks 8 inches in diameter that were completely sunk, buried out of sight, by the labours of these miners *before the wood was at all rotted.* This would mean an upheaval in that place of at least 8 inches in less than 5 years.

Darwin concluded that the earthworms in five years bring up soil enough to cover the ground one inch thick; and that, therefore, the result of their labour is of vast importance. I reckon that the Pocket-gopher does this much in five months. It does not do it in the same way or so effectively, because the earthworm actually digests the substance of its castings; but it is evident that the Gopher's method answers the purpose of fully disintegrating and mixing the dead vegetation with the soil to produce a rich and fertile black loam.

---

[9] "Pieces of wood, 2¾ inches square, were buried to the depth of 1 inch in the ground, and decayed in the following order: Lime, American birch, alder, and aspen in 3 years, etc. etc." J. H. Balfour, Manual of Botany, 1855, London and Glasgow, p. 45.

From these observations, we may form some idea of the work toward tilling and draining the ground done by this continental army of rodents, and it is possible that they cause still greater changes by bringing such vast quantities of soil under the influence of the sun and wind.

Their aggregate power as active geological agents must be immense; and when we stand on the banks of the Mississippi, and watch that turbid river bearing its 400,000,000,000 tons of mud per annum to the sea, i.e., 1 square mile, about 240 feet deep,[10] for the manufacture of new continents, we should realize that a great many thousand million tons of that flood-borne silt is simply the débris from the workshop of the *Geomyidæ.*

---

[10] Humphrey & Abbott, Physics and Hydraulics of the Mississippi River, Phila., 1861.

LIFE LXXXIV KANGAROO-RAT

PAGE
Names 420
Description: Size, Colour 420
Races 421
The Land of His People 421
The Children of the Sand 421
Their Home—the Desert 422
The Kangaroo-rat of the Desert . . . 424
The Abundance of His Food 424
His Drinking Habits 426
His Mound and Its Secrets 427
Chambers and Nest 428
His Way of Life 429
His Sociable Bent 431
His Equipment for the Battle 433
His Speed and His Foes 434
In the Firelight 434
His Love-life a Secret 436
A Night on the Desert 436

References 440

Kangaroo-rat, Big Kangaroo-rat, Desert Dipo, Four-toed Rat, Kangaroo-rat of the Desert, Desert Rat, Jumper, Two-tracks

Dipodomys deserti Stephens

(Gr., *di*, two; *pous*, foot; *Mys*, a Mouse; L. *deserti*, of the desert)

Dipodomys deserti STEPHENS, 1887, Amer. Nat., Vol. XXI, Jan., p. 42.

Type Locality—Mohave River, San Bernardino Co., Calif.

The Family *Heteromyidæ* is composed of mouse-like rodents with cheek-pouches. The name may be translated "freak-mice," for they differ much from all the rest of the Mouse world. The name "Jumpers" would have been better. The language sense of the plainsman has named them "Kangaroo-rats," which is an excellent name, connoting their most striking characteristic—that is, they sit up on their tail and hind legs like Kangaroos; and, when forced to full speed, make their best time on two legs.

They are further marked by having two large fur-lined pockets—not in their pants, as in the true Kangaroos, but in their cheeks, one on each side. In them, the large ones can carry a heaping tablespoonful of grain, which is a full ration.

The Family comprises Kangaroo-rats, Spiny Pocket-mice, Pocket-mice, and Pigmy Kangaroo-rats. The first form the genus *Dipodomys*.

The genus *Dipodomys* (Gray, 1841) is composed of small rat- or mouse-like creatures resembling the Jerboas of Africa. They have soft brown or gray fur, with white underparts; no spots or stripes; very small fore feet, and very large and long hind feet with but 4 toes; tail, very long and slender; ears, short and round; eyes, big and bright; cheek-pouches, well developed. Upper incisors deeply grooved.

$$\text{Teeth:}\quad \text{Inc. } \frac{1-1}{1-1};\ \text{mol. } \frac{3-3}{3-3} = 16$$

The Desert Kangaroo-rat has, in addition to the family and generic characters, the following:

Size. Male, length, 13 in. (330 mm.); tail, 7½ in. (190 mm.); hind foot, 2⅛ in. (53 mm.).

Colour. General colour above, a soft, pale creamy fawn. The lower half of each hair is pale, clear leaden, almost lilac; this shows through, and gives a suggestion of lilac to the whole mantle. All the lower parts are snowy white, which begins rather sharply on lips and cheeks, and continues along shoulders, flanks, and hams to the base of the tail; on the back of the hind leg, is an island of buff; on the cheek under the ear, is another. From the base of the ear backward, is a splash of white, as in most of the genus. The tail is sharply bicoloured, but the band of back colour that runs down the upper side is very narrow, barely ¼ of the whole. The hairy tuft or pencil shares the bicolouration.

The sexes are alike in colour.

RACES

deserti Stephens, the typical form. T. l., Mohave River, Calif.

sonoriensis Goldman, like *deserti*, but upper parts darker; the buffing, vinaceous instead of ochraceous tone. T. l., near Sierra Seri, Sonora, Mex.

THE LAND OF HIS PEOPLE[1]

The vast area that the *Heteromyidæ* inhabit extends from Washington and Manitoba to Panama. It is, for the most part, a dry region of fierce summers; what the winter is, matters little for they hide underground when it is too cool to be pleasant.

One group of the family is found in the forest region of the South, and even in damp countries. But the highest developed, the largest and most beautiful, are found only on the true deserts—the dryer, the better—so that the burning sand wastes of the Mohave and the Colorado have been the environment that created the Desert Rat, the Big Kangaroo-rat, or *Dipodomys deserti.*

THE CHILDREN OF THE SAND

At least as far back as 1848, it was discovered that our waterless plains were inhabited by certain remarkable animals, known as Kangaroo-rats. Since then, nearly a hundred different kinds have been discovered by scientists, and described, covering most of the arid and semi-arid plains of the West from Canada to Southern Mexico. The little Pocket-bearers of the *Perognathus* group, have a range of vast extent; but the superb Jumpers of the *Dipodomys* genus, are confined to a very restricted area.

---

[1] This Life was written in the spring of 1919, and read before the Biological Society of Washington, Jan. 24, 1920. In condensed form, under title of "Dipo, Sprite of the Desert," it was published in the Century Magazine, Nov., 1922, pp. 106–15; 8 drawings by the author.

One of the earliest described of these is the Desert Kangaroo-rat, *Dipodomys deserti* Stephens (1887), a typical native of the Mohave and Colorado deserts.

Though less plentiful than some of its smaller cousins, the *Dipodomys*, may still be called abundant. In order to reach an estimate of their numbers, I made a careful survey of a quarter of an acre near Victorville, Calif., March, 1919. Counting the holes evidently inhabited, there were on this, 3 of Big Kangaroos, 7 of Little Kangaroos, 9 of Calling Mice, and 1 of Gopher. This rate would give over 7,000 Big Kangaroo-rats to the square mile; but we must remember that there are wide areas without any of these creatures, which would greatly reduce the figure.

Nevertheless, on certain parts of the Mohave Desert, 1,000 pairs to the square mile seems within the bounds of probability. And how big is their country? An examination of Map IX (p. 279) shows that the area inhabited by the Big Kangaroo-rat is about 750,000 square miles. But probably not more than one third of this is quite to their taste. We have estimated that there may be 1,000 to the square mile; this would mean about 200,000,000 Kangaroo-rats on the range. It is too good to be true. I cannot credit it, and yet it does seem safe to assume that there are many millions of Kangaroo-rats disporting themselves on our deserts every night.

THEIR HOME—THE DESERT

Oh, why do they call it desert? A desert is commonly understood to mean a barren, burning land deserted by all living things—even plants—cheerless, dreary, appalling, and death-dealing. It would be hard to get further from the truth than this, if the Mohave be a true desert.

Imagine a broad and somewhat level sandy plain, dotted over thickly with low shrubs—chiefly creosote or shadscale—with occasional cactus, and here and there scattering groves of palmlike yuccas, casual patches of greening herbs just thick enough to tinge the middle distance with their green or grapelike bloom, but melting into a golden haze that masks the far-off hills. Some twenty miles away, they rise and starkly butt into towering naked granite peaks of purple, shot with golden lights—peaks that rise up, up, abruptly up, to bear each, high above his noble shoulders in the gentle blue, a crown of white—the crown without which no mountain ever can be in the noblest rank—a cap of shining snow, a blazoned promise that this year the blessedness of water shall not fail.

Yes, this is the desert, at a hasty glance—the desert in its poorest time—the time of bleak and dusty winter winds. But spring comes here as well

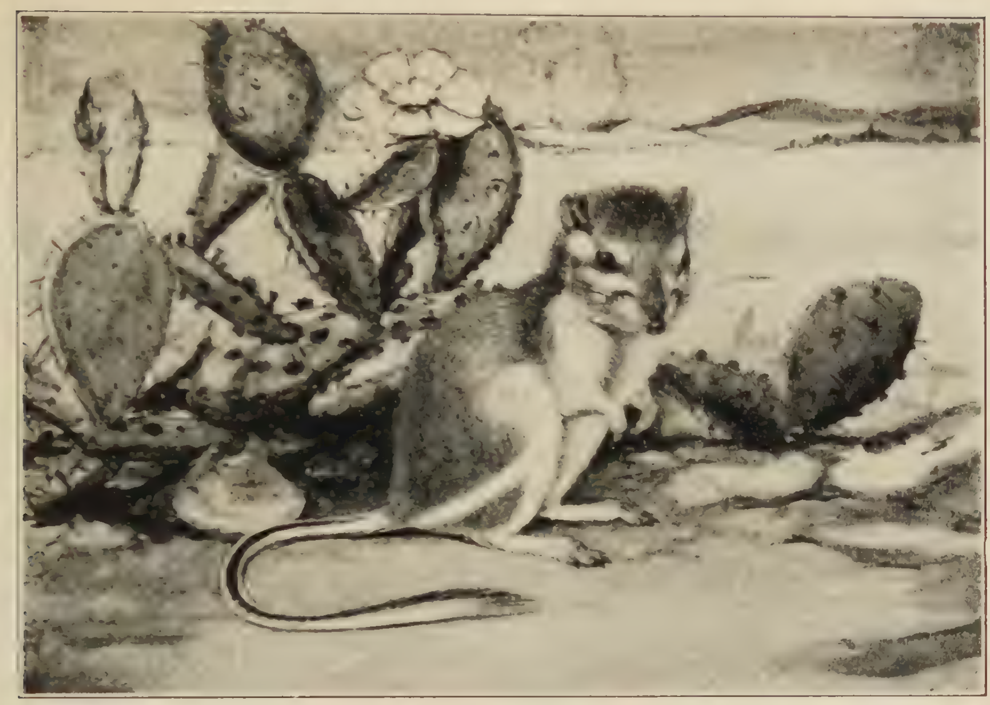


PLATE XLIX.—KANGAROO RAT

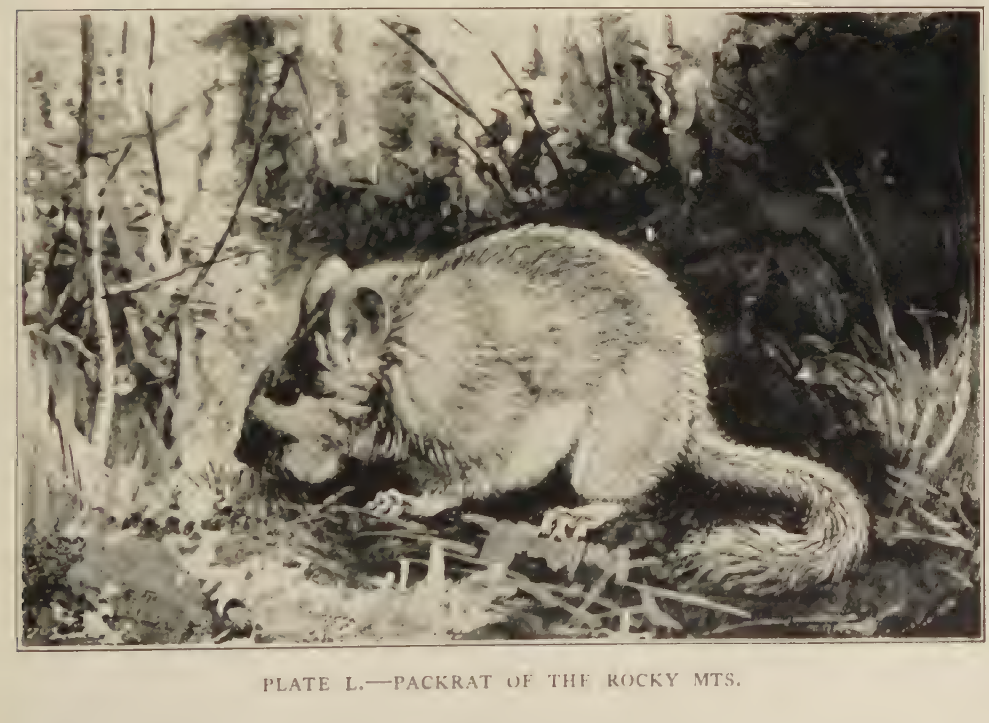


PLATE L.—PACKRAT OF THE ROCKY MTS.

PLATE LIII.—FAMILY OF BEAVERS

(*Castor canadensis* Kuhl)
The pair in the water are having a friendly nibbling match

as anywhere. And when the parsimonious rain has laid the dust, when the creosote has begotten for itself a deeper green, when the corpselike sage looks vitalized again, and the cactus, most reptilian of plant life, puts on a semblance of aliveness spelled in orchid terms, the deadly sand responds with a plain-wide sheen of bloom that beggars language to forthtell; flowers that numb the brain's perception with their exquisite multiplicity, their wondrous unexpectedness, their boundless gladness in the spring that they so delicately express; not lush, not rank, not crowded, but everywhere in beds, clusters, and little brotherhoods, that nothing in the world, but perhaps the mountain meadows in July, can equal for joyous profusion; and nothing anywhere, not even those on the arctic summer plains, can faintly approach in the tender delicacy of each exquisite and low-hung bloom.

Nevertheless, I am but describing the frame of the picture, the setting of the jewel that really claims my thought. For the desert is the home of higher things than flowers; and every sandy place between the scattering blue-eyes or the low, flat loco-weed is pattered over with an endless ever-changing maze of four-foot tracks and trails.

Never before has it been my lot to sojourn in a spot that, for superabundance of harmless, beautiful wild life, can compare with the desert. Africa may have a larger animal population on some parts of its tropic breadth, but that is country unknown to me. In America, where I have travelled and watched the wild life from Arctic to Tropic, and from Atlantic to the sundown sea, I have never seen a place that could compare with the great Mohave Desert, for the abundance and variety of its bright-eyed, fur-clad creatures. Every one of the millions of low bushes has a home in its roots—large or small, according to its owner's fashion, and marked with the owner's name and ways, in characters that the desert hunter knows.

The hard or leafy forest floor of other lands betrays no sign of the Mouse or Fox that passed an hour ago; but the finely sifted desert sand tells all. Here, on every side, we see them—the chains of tracks, the hunter signs, the confluent trails that mark these little peoples' streets, and point the well-worn thresholds of their open doors. Big and little, small and very small, they wind about, lead to the holes and feeding grounds, or tell some story of their lives, their loves, their tragic ends.

Here, in pedoscriptic record, are Cottontails, Jack-rabbits, Ground-squirrels, Chipmunks, Packrats, Gophers, Kangaroo-rats, Calling Mice, Deermice, lizards—harmless children of the sun—with their overlords the Coyote, the Badger, the Desert Fox, the hawk, the raven, and the owl; and their Bolsheviki, the scorpion, the chuckawalla, and the deadly rattlesnake. If anything, I keep my eyes too closely on the ground—an old failing of mine. I miss many a glory of the hills that my companion is rejoicing in, but I find what I seek, the maze unravels just a little bit. Here are some tracks of a kind that I knew in my early days on the Panhandle Plains, the twin-tracked, long-tailed marks of the little Kangaroos. But I am seeking for a better beastie; and it is something like thrill that possesses me, when a like, but larger track, appears. Its lead is to a hole that was surely made by the Big Kangaroo of the sandy Plains.

I had come here to find the Peace of the Desert, for I needed rest; but the special creature that I sought was this of the two-footed trail.

And now I have a shameful confession to make. Because I wished to study this creature, I set a rat-trap at the doorway. Next morning, I found, death-clutched in its iron jaws, the most exquisite, velvety, fawn-eyed, long-tailed wild thing I had ever seen uncaged.

The Kangaroo-rat of the Desert

This was the creature I had trailed and trapped; and the question at once arises, if its species is so numerous, why did I see none till the ruthless method was employed? Because the Desert Sprites are strictly nocturnal in habit. They are gifted with night-eyes and with delicate bodies. They suffer from the heat of strong sunlight. Their ideal time is when the wonderful starlit night is on the plains. The camper sees them gliding by, or shooting through the gloom, just beyond his fire's light; the early teamster scares them from the oat bin. But every one that I chanced on—and they were many—was in the light of the motor car crossing the trails of the Mohave by night.

I learned their habits mostly by reading the myriads of tracks that they leave on the desert sands. These are fresh every night, for the winds of noontime commonly sweep the plains again and leave the surface smooth for a new inscription.

The Abundance of His Food

The desert, in spite of the picture conjured up by the name, produces over 200 different trees and shrubs, and a much longer list of flowers and grasses; most of them, with their seed, are found to furnish sustenance for the children of the sand.

The first to investigate the food of the *Dipodomys* was Frank Stephens, the San Diego naturalist. He caught a Desert Dipo in November, when food was scarce; and writes that, as soon as he put the captive in a cage with some grain, it began fearlessly and eagerly to fill its pockets, stuffing them so full of the new-found food that they must have hurt. "It would not stop to eat," he says, "but hunted about for some exit; not finding one, it ejected the contents of its pockets in a corner out of the firelight, and went back for more. This time, it ate a little grain, but soon gathered the remainder, and deposited it with the first. After eating a little more, it refilled its pockets, and hunted about for a better place to make a cache, seeming to think its first choice insecure. . . .

"The pockets are filled by the fore feet, used as hands. The filling is done so rapidly that, when a hard grain, like wheat, is used, a continuous rattling sound is made. The ejection of the grain is aided by a forward squeezing motion of the fore feet, each foot making two or three quick forward passes scarcely occupying a second of time."[2]

Bailey says:[3] "They carry considerable food into the burrows to be eaten probably during the day, as shown by deposits in their chambers, by the shells of seeds and grain brought outside during housecleaning, or found scattered over their chamber floors; and by the presence of seeds in the fur-lined pouches of individuals caught in traps."

Of a related species (*elator*), Prof. David E. Lantz gives an illustrative incident.[4] "Mr. Laurie, living in Chattanooga [Okla.] has a cave back of his hardware store, in which a pair of Kangaroo-rats had taken up their winter quarters. He purchased a couple of bushels of wheat, to feed to his poultry, and placed it in the cave. Some time later, when he wished to begin to use it, he found that it had all disappeared. Last spring, he removed some boards which lined the lower part of the cave on the inside; and found all of the wheat carefully stored away behind the boards by the Kangaroo-rats." A couple of bushels: 2,000 ounces; 10,000 pocketfuls for the Rats! What industry!

Of one caught alive, Lantz writes: "It had been foraging in a Kafir-corn field, and I found its pouches widely distended with grain. They contained 100 seeds of Kafir corn, and 65 seeds of *Solanum rostratum*,"[5] which also illustrates the capacity of the pockets.

As further indirect light, Bailey notes of the kindred species (*merriami*): They "feed on the ripe seeds of various plants, or carry them into the burrows to be eaten at leisure. Often, when caught in traps, their cheek-pouches are stuffed with seeds or with the rolled oats used for trap bait. Occasionally, a bit of green leaf is discovered in the pockets; but usually only the fine white pulp of ripe seeds is found in their stomachs."[6]

---

[2] Calif. Mamm., pp. 157–58.

[3] Texas, p. 148.

[4] As above, p. 149.

[5] As above.

Later Bailey lists many green plants eaten.[7]

This agrees with my own observations; for I commonly found in their stomachs a mass of green stuff ground up to a smooth dope. The March dietary was chiefly of greens; and quantities of the flat dandelion (*Anisocoma acaule*) were found in their storerooms; also wild mustard (*Sophia*), little borrage (*Orecarya*), water leaf (*Phacelia*), and a number of others not identified. In their cheek-pouches, I found a stock of the little mustard (*Sophia*), and a little of the evening primrose (*Sphærostigma*).

When given choice, the Dipos seem to prefer grain, even of imported kinds, which I consider disloyalty—but they love the seeds of the desert, including all manner of its native fruits and berries. They take readily to most of our garden green stuff.

All of this, combined with the observations of other naturalists, comes near proving that the Kangaroo-rat eats most anything that grows green on the desert—with the inevitable exception of the creosote bush. That vile, bright-hued native of the drifting sand, that Skunk among shrubs, has protected itself most effectively from all its would-be devourers by a pungent repulsive odour, that is excelled only by its yet more disgusting taste. I know of no desert creature that will touch a shred of it, be he never so hungry.

His Drinking Habits

The photos and the sketches show also a sign or trace that is not a track —the little signatures or prospect holes that pit the surface of the sand anew each night. In one case, there were ten of them all close together.

It is obvious that these are not made so continually without a purpose. They are not the beginnings of a burrow, being different in place and character from a new hole-up or den. The only explanation I see for them, is that they are made as prospect holes.

For what? There are many little tubers near the surface, and sprouting seeds are a choice food, with more moisture than those gotten on the sand. The Kangaroo-rats, guided by scent, may have been after these, but I could not make sure. It was no use examining the hole after the digger had secured the bait; but, digging in similar places, I got a caterpillar and a common doodle-bug about an inch and a half underground.

At another place, I saw a burrow of half-inch calibre. I followed it down

---

[6] Texas, p. 150, corrected by Bailey, 1927.

[7] Water Supply, p. 73.

3 or 4 inches, and along for 6. There it forked; and 2 or 3 inches farther, at the end of each fork, there was, curled up, a luscious, flesh-coloured grasshopper. Now I began to believe that it was in search of these that the Dipo dug the many little holes; possibly that these insects serve the Rats in the place of drink.

Bailey, however, takes an emphatically different view. After years of study, he writes me (Feb. 8, 1927) that the Dipodomys "never eats insects, under any circumstances, and gets all the water it wants from green vegetation, roots, bulbs, tubers, etc." On this subject, he has published an important paper (Water Supply, see References) in which he shows that the desert plants yield 70 or 80 per cent. of water; and in these, the Desert Rats find an abundant supply of drink.

One of them "killed in a snap trap, had its pockets filled with the little juicy tubers of a small *Portulaca* that grows abundantly over the desert, and is generally available an inch or two below the surface of the ground, even during a drought of several years. Enough of these were carried in the cheek pockets at one time to supply moisture for several days."[8]

This, indeed, is sure: A Desert Rat never drinks a drop of fluid from the day he leaves his mother's lap till he takes his last sleep in the remotest corner of his self-made catacomb. Dry—bone-dry—is his life. Normally he never has a chance to drink, and doesn't want one. Nothing would disgust him more than a beverage forced on him—unless perhaps a bath. The juices of the dry plants and bulbous roots are enough to appease his microscopic thirst—so much so that it has been suggested that the chemic action of his stomach produces synthetic water from some very unpromising fibres, that, to our imperfect senses, seem as dry as a bell rope. To sum up, then, when we note the prospect hole of Dipo, it means he was not after food—he was after drink. He was sinking a well! and its treasure took the form of a big bulbous root.

His Mound and Its Secrets

By far the most conspicuous evidences of the Kangaroo-rat population is the rat-house or mound. This is a heap of sand about the roots of some desert bush; with a number of entrances, some open, some closed, most going in level like a railroad tunnel, but one or two straight down like a miner's shaft.

There are many different mounds pierced by the burrows of the desert creatures, but the size of the entrance will usually proclaim the owner. There are great variations in the length and complexity of the burrows made by this species, from the simple tunnel 4 or 5 feet long with one or two entrances, to the great mound with a dozen doorways and a labyrinth of burrows—the result of years of labour and generations of occupants.

---

[8] Water Supply, p. 73.

As already noted, the Kangaroo-rats and their labyrinths are very abundant in some localities, so that the light, sandy ground is honeycombed with burrows close to the surface. Here a man commonly breaks through, while to a Horse the walking becomes laborious and disquieting. The Horses of the desert, however, soon learn to recognize and avoid these plots of treacherous footing.

On March 22, 1919, I selected one of the large mounds for examination. It was about 10 feet across and 2 feet high. To make sure of the owner's identity, I set a rat-trap at the doorway of the labyrinth, using a bread bait. The next morning, I had, as already noted, a large male Kangaroo-rat of the finest type. The entrances to the burrow were about 3½ inches wide, and 3¼ inches high; most were of the usual style—that is, going in nearly level. Three of them, however, had the door closed; that is, were plugged. Two were plunge holes that went straight down, and were open. These may have been ventilators, or may have been for rapid escape when hard pressed by an enemy. Six hours' hard digging, with three young assistants, resulted in the diagram herewith (Plate LII, p. 435).

The mound contained about 75 feet of galleries, 10 entrances, 7 chambers, 12 storerooms, 3 dung-pockets; and was 3½ feet underground at the lowest point.

Chambers and Nest

The chambers were of two types—commodious, well-developed rooms, and mere enlargements of the tunnel so that individuals might pass each other or feed. Of the former, there were 3; of the latter, 4. Of these, A was about 8 by 10, by 5 inches high. It was probably a mere assembly room and meeting place, for the family going forth or coming back.

The lowest—the one that I call the winter Banquet Hall—was 3 feet below all frost-reach, in the centre of the mound. It was quite spacious, that is, 9 by 12 inches, with 5 inches of head-room. It was too far down and too wide to be a mere switch crossing. It was not a sleeping room, for it had no bedding, and it was much too large. But there was a store of food near by; and, just beyond that, a toilet room or dung-pocket, whose pellets, of which there was a great pile, were composed of woody fibre from the leaves and stems of plants, and of the light colour and dry sawdust texture that is the usual product of winter fare. If, then, this Hall was not used for winter feasting, I do not know its purpose.

Only one of the chambers contained a nest. This was at the lowest portion of the burrow, and the chamber was 6 inches wide by 5 inches high. The nest completely filled the chamber, and was made of a mass of finely chewed, soft plant fibres mixed with feathers of turkeys, guinea fowls, and chickens, from the barnyard 200 yards away; and with bright red feathers from the breast of the crimson linnet as a contribution from the wild things. A soft, warm, dry nest it was, prepared for the young whose coming was many weeks ahead, and not yet forecast even by the instincts of the time—a delightful case of the home instinct running ahead of the mother instinct.

Mixed with the nest were many scattered bits of green leaves; alongside was a food cache of recently dried plants—enough, perhaps, to fill the Rat's pockets two or three times.

Then, questionably near, was the baby dung-pocket, or sanitation department expressly for the children. The pellets in this numbered 50 or 60, and were of the juvenile size; one or two, however, were from adults, showing that they also might use it under stress. The condition of the pellets showed that they dated from the previous season. Among these, and in the material of the nest, were many little beetles of the scavenger kind (*Ptomophagus consobrinus*, Lec.). Admirably sanitated was this elaborate house with its modern improvements—drainage, ventilation and dry earth closets, complete at all points, most convenient for a hurry call.

The Thornbush, or Dance Hall, seemed of chief importance. It was 18 inches down from the top of the mound, roofed and rafted by the great mesquite, that was at once roof-tree, armed warden, and beacon from afar, faithfully standing on duty, night and day.

In size, the room was but little larger than the Banquet Hall, with an antechamber and 6 doorways, but no dung-pocket near, probably because so handy for outdoors. What was its purpose?

Evidence that these exquisite creatures are as fussy about their persons as about their dwellings, is found in the note that Stephens makes on a couple that he trapped. On arriving with them, he "put a little dry earth in the cage. This pleased the Pocket-rats, and they enjoyed a good dust bath, rolling in the earth, and pushing along on their bellies. They looked much better for their dust bath, the roughened pelage becoming smooth and glossy."[9]

HIS WAY OF LIFE

In my experience, all sociable animals have games, which combine the pleasures of fellowship with exercise of their best developed power. From which it seems the Kangaroo-rats should meet together in some prepared place, to play hopscotch, leapfrog, or other forms of high-hopping. But, so far as outdoor games are concerned, I have no evidence that is conclusive or reliable—a disappointment for me, but a happy possibility for some later watcher.

---

[9] Calif. Mamm., p. 157.

Nevertheless, I have referred to the Dancing Hall as a place of indoor frolic. Being less than a foot across, with barely 5 inches of headroom, it could scarcely afford playground for creatures that can leap 3 or 4 feet high and 10 feet along. The room itself is inadequate for a foot race or even a cotillion. It might do for a wrestling match, but it seems more likely that the long gallery itself gives the opportunity they need, maybe for a scamper or a game of tag.

All this, however, is mere surmise; and the following are all the facts behind the guess; there are rough and stormy days on the desert in winter time; both frost and snow are supreme for spells. During these, the Kangaroos do not sally forth. Do they hibernate? Apparently not, for all creatures which hibernate, prepare with a heavy padded overcoat of fat under their skins; and disappear in autumn to be seen no more till springtime. The Kangaroo-rat does not get a fat-layer, and he comes out whenever the weather is fine. So that all evidence points to active life underground, even in winter—life which must find its central place far below the frost in the Great Hall—that this hall, therefore, is truly a carrousel, or hall of play and feasting.

There is one other remarkable circumstance about the labyrinth. In order to keep out enemies, the doorways are stopped with earth when the owner is inside. Some of the doorways were thus closed in the great burrow. Some, however, were not. I do not know why the difference.

Bailey says:[10] "Usually, one or more of the doorways are closed each morning with earth behind the retiring inmates, probably to keep out rattlesnakes and other unwelcome guests. At night, these earth doors are opened for use; and the best place to set a trap for the animal is in front of a closed, rather than an open door. While all of the holes are used more or less at night, apparently only the closed ones are occupied in the daytime."

These, then, are the uses of the complex burrow and its rooms, etc.: It is a refuge from enemies and from the weather, a sleeping, eating, breeding place, a playground and storehouse, a place of pleasant meeting with friends. It is, therefore, in the fullest, broadest, human sense, *a home*. And apparently it is carried on by generation after generation.

---

[10] Texas, p. 148.

The night before, I had captured a male. At this season, they may be in pairs; so, in digging out the labyrinth, we kept a keen watch for another inmate. Four hours of digging brought us to our noon halt; there was still an unexplored portion below the first map. We were tired mentally, as well as in limb; and nothing but dogged determination made us resume the digging. Our reward was complete, for at the end of two hours more, we found the nest—the centre of it all—and, finally, at the very last of the last gallery, we unearthed and captured the female Kangaroo-rat, and bore her home in triumph. She struggled violently, but, as usual, made no attempt to bite, and uttered neither squeak nor snarl.

His Sociable Bent

The mound, with its many caves and passages, is the home of one pair usually; but it seems that, in some cases, the family remains with the old folks. For the Kangaroo-rat is a sociable little creature—so sociable that it is commonly found in colonies. The desert, at some places, may be so thickly inhabited that there are mounds every 20 or 30 feet; while, leading from one to another, is a network of the well-worn trails, veritable streets and highways in their friendly village.

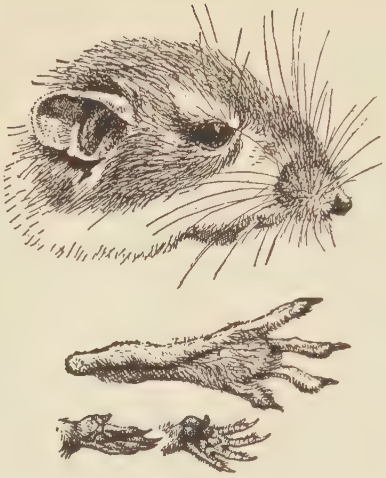
Being sociable, the Dipos must have means of communication with each other. One of the most important, is indicated by Bailey.[11] "That the inmates of these mounds," he says, "are not always asleep during the daytime, can be proved by tapping or scratching at the entrance of the burrow, and then listening for a response. A low, drumming sound can usually be heard from deep underground, sometimes from two or three points. Apparently, it is made as the similar drumming of the Wood-rats is known to be, by beating the soles of the hind feet rapidly on the ground, which produces a tiny, vibrating roar; and is used as a signal of alarm, call note, or challenge."

So far as the records go, the Kangaroo-rat has no vocal call note, and squeaks only when a war-whoop seems justified. But he would be unlike all his kinsfolk if he did not have sounds to express greeting, pain, anger, and pleasure—yes, even a prolonged love-song for the mating season. This is a matter for fuller observation.

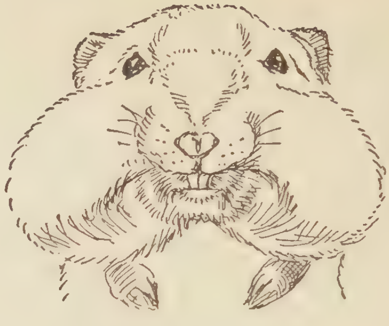
The species has apparently another mode of intercommunication, that is very important if one may judge by the apparatus through which it is effected. On the back, between the shoulders, is a large, unctuous gland that secretes a waxy matter of peculiar smell. This is found in both sexes, and is fully illustrated in Plate LI (p. 432).

---

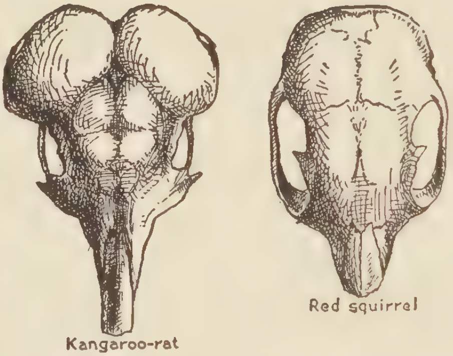
[11] Texas, p. 148.



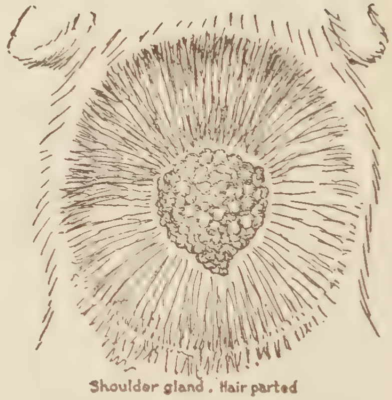
Dipo's head and feet



Dipo with pouches filled



Skull showing the direction-lobes of the kangaroo-rat



The scent-gland between the shoulders

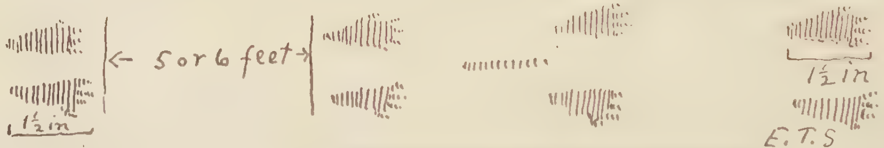


Plate LI. Details of Dipo.

The analogy of these sebaceous glands in other animals, points with certainty to their use as a means of communication. The fact that they are enlarged, and more active in the breeding season, shows that at that time there is urgent need of the animals communicating and getting together.

These smell-glands are always placed so that they easily touch prominent points in the creature's ordinary surroundings. With this well-known fact in mind, I assumed that I should find projecting roots, stones or stems, at corners, or along the *Dipodomys* highway, anointed with the news-diffusing wax—marked with his self-inking rubber stamp.

But I was doomed to disappointment. So far, I have found no proof of the theory, though I searched diligently.

His Equipment for the Battle

On skinning a Kangaroo-rat, one is struck at once by the enormous development of the ear-bulbs. They positively misshape the head; they give it an unusual basal width that combines with its sharp snout to make the head as triangular as an arrow point.

It has commonly been assumed that this great specialization is due to its highly developed hearing. But the external ears are *not* highly developed. The animal is not very sensitive to sounds, as I proved by experiments on captives and on wild ones. The most flourishing colony I saw, was at The Needles among the eternally fluttering, scraping, screeching, squeaking, rasping tins, paper and garbage of the town dump.

Then it occurred to me that the bulbs were maybe not developments of the ear at all, but of the direction and balance organ—the gyroscope. With this in mind, I took specimens to Dr. Harry Garcelon, the well known ear specialist of Los Angeles. After carefully dissecting one or more, he reported:

"These huge bullæ certainly have nothing to do with hearing. They have a little fluid in them, but no opening to the ear. They are either organs of direction or vibration measurement, probably the former."

The service, then, that they likely render, is to enable the Kangaroo-rat to find his way about with certainty in his labyrinthine, black-dark burrow underground; and to equip him for headlong flight straight home over the unlandmarked desert, when the bounding Coyote or the skimming owl has marked him for its prey.

The Kangaroo-rat will not go farther than he can help to find his food. A hundred yards around his village, seems, by the tracks and the herbage, to be far enough. Hitherto, I have heard of no food in the storehouse that was evidently brought from any great distance. Yet Dr. Garcelon tells me that he has often surprised the animals when in the alfalfa field 400 or 500 feet from any possible burrow. Nevertheless, 200 yards on the featureless alfalfa, or the even, gray sage desert, may be quite far enough to call for an exquisite sense of direction when a danger call sends the Rat a-flying homeward.

HIS SPEED AND HIS FOES

What may be his flying rate when urged to his best? I have little direct evidence but this: First, the statement of Frank Stephens, who "never knew a Dog to catch one, as they get under way very quickly, and vanish in the nearest burrow."[12] Next, the tracks show that he can cover 6 or 8 feet at a hop when so minded, and keep it going for some time; which puts him in the same class of speeders as his cousins, the Jerboas, that are said to move like an arrow, and be safe from all marauders, furred or feathered, if given a fair field. Last, I know that he must be swifter than the Desert Fox and the Coyote, or long ago his race would have ceased to exist.

But the Jumper has formidable enemies to reckon with. The screech owl by night is known to prey on him. Maybe this and the burrowing owl are the only creatures that can take him on the wing. There is a record of a Kangaroo-rat eaten by a marsh hawk.[13] The rattlesnake in some way can secure him mostly, it is believed, by following into the den. The scorpion too may be a plague, at least in the Desert Rat nursery; for he uses their burrows for harbour, and is rudely resentful of other wayfarers sharing them. On one occasion, when digging out a Rat with my hands, I pulled out a "handful of scorpion." The sand that was also in my clutch muffled his string. I dropped him in time, and then came the judgment day—for him.

The Weasel, the Badger, the Fox, and the Coyote are to be feared, for they can tear down the Kangaroo's castle, rout him from his bed, and nab him even as I did, in spite of his speed.

To man, the Dipo must give thanks for another bane. The Jumpers that I met on the prairie were seen after nightfall by the sudden light of a motor car. Not a few are killed at such times, for the blazing light dazzles and confuses them beyond the power of quick escape. More than one observer has noted that a light attracts them; and they may be captured by a combination of jack-light and net. This is indeed a failing of all true night-folk.

IN THE FIRELIGHT

A charming glimpse of their social ways, is given by the naturalist, Nelson,[11] who watched them playing around his feet, as he sat by the nightly

---

[12] Calif. Mamm., p. 157.

[13] Fisher, Hawks and Owls, 1893, p. 31.

[14] W. A. N. A., p. 503.

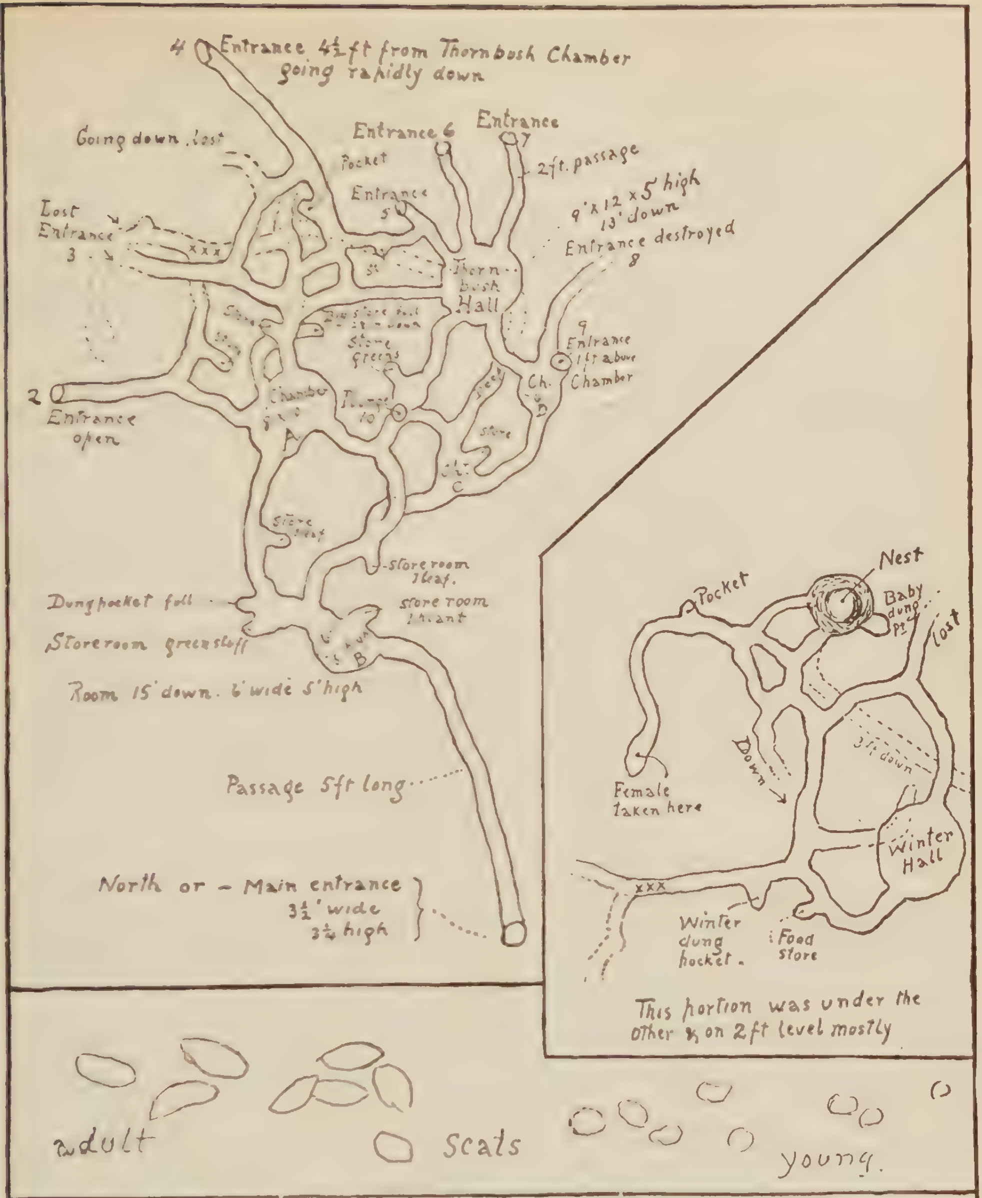


Plate LII. Big Kangaroo-rat's Burrow etc.
Mohave Desert. Calif
March 22. 1919 – E.T.S.

camp fire, baiting them with rice. He could stroke their backs, and even pick them up without scaring them away. They might struggle a little on feeling the clutch of the hand, but they neither bit nor squeaked.

Among themselves, they were less peaceful. Often, they fought for the grain prizes he offered. Their mode was kicking fiercely with the hind feet. A squarely delivered blow of those powerful limbs was enough to down any Kangaroo-rat and end the fight. During these combats, their war-whoops were recorded as a succession of squeaks.

But these were bloodless combats, trials of strength without ill-will; and, so far as known, the Dipo keeps such sparring matches among his own kin. At times, however, Vernon Bailey tells me, two Dipos indulge in a murderous finish fight; and they do, they are "the most savage fighters known."

His Love-life a Secret

We never really know a bird till we have heard its love-song and seen its nest and eggs. This is true of all wild creatures, and serves us with notice that we do not yet know Dipo. We have found the nest, indeed, but know nothing of the love-song or the courting, of the young, or the rearing, or the family life of our high-born son of the desert.

We know from morbid observation, that Dipo has from 2 to 6 young at a brood. I found evidence that these would appear in early April; and there are records of other births in the family to dot the whole year.

A Night on the Desert

The fireball sun has set behind the peaks of Bernardino. The purple of the eastern sky flows down like wine, and fills the wide basin of the desert—first in the hollows it appears; then, as it rises, flushes the flats, and later, one by one, the higher spots, till all are overwhelmed.

The singing Coyote and the dancing owl are out already—though they reckon themselves of the night folk—and still the afterglow is strong behind the peaks.

But the purple floods the gold; the stars are lit—the big, bright kind are they—not seen in other lands. It is night.

Of all the creatures of the desert eve, the Kangaroo-rat most insistent seems on very gloom; not a vestige of twilight does he willingly accept. Of all the thousand Rats whose tracks I daily crossed, not one did I see in hours of light.

In some wise way, the peoples of the underworld seem to know when the gloom they love is on the earth above. And forth at the right time, from his deep-down nest comes the Desert Rat, followed, jostled, or led by his mate. He digs and pushes his way through the sand-pile barricade.

For a moment, they peek from the hole, then venture out with a timid hop. They sense the breeze, they listen, they smell and peer—a Wildcat or a Coyote may be just behind the bush that is their roof-tree; that crooked root may be a rattlesnake. But, no, the coast is clear. They dig the doorway free of sand-bars, so it is wide open; and forth they fare a-foraging—without a good-bye sign, each on a different way.

When a small boy raids an orchard, he begins eating a selected apple; but stuffs as many as possible into his pockets very quickly, and makes ready to dash for safety the moment there is any alarm. This is the Jumper's method when he goes forth to seek his meat. Hopping high like a Kangaroo on two legs, and balanced by his tail, taking from time to time an extra high hop to look around—for "Stop, Look, and Listen" is his watchword—he comes at last to the feeding ground, ever farther from his home as the near supply is used up. Ripe and green seeds in great variety, delicate grass bulbs, tiny tubers, juicy sprouts, furnish the solid food, while tender leaves, evening primrose, and little borrage serve for greens. In wild mustard leaf and water-leaf he finds a delectable salad.

At one or more places, he thought he smelled other buried treasure, and sank little prospect holes; but without success. He passes on lightly, senses the trunk of a tall creosote, rubs his back ink-pad on it, to let his wife know he has been there, leaps high in the air to take a look around—and has the ill-luck to catch the eye of a foraging screech owl. In a moment, the big, silent air-marauder comes swooping. But the Jumper is alert. In two leaps, he is under a sheltering cactus where he is safe; and at once, he drums with his hind feet on the sand—a danger signal for his family, and friends—a signal whose timely warning makes them perfectly secure. And the baffled owl goes careering afar, to try some more promising field.

Dipo is no more upset by the incident than is the visitor at a zoo, when the caged Leopard makes a futile slap at him through the distant bars. Hoppity-hop he goes on his two long legs, with his tail upcurved. As he bounds, he keeps his two dainty white-gloved hands tight against his chest; they serve as hands and as diggers, but never as feet; except on rare occasions when, boylike, he goes on all-fours.

The seeded spear-head of a grass attracts his eye. It smells tempting. Good luck! The seeds are in it still. With vibrant nose and lips team-working to his teeth and dainty paws, he threshes the little harvest then and there; and the seeds, except for the samples used as test, are stored in his ample cheek-pouches. Already these contain other seeds and a number of delicious leaves; but never, so far as known, are they used to carry berries or any squashy food. What would the furry lining be like if such untidiness were indulged in?

Making a long cast to seek new forage, and a high hop for observation, he sees a strange-looking object like a big moon in the distant sage. It is very bright and attractive. He is drawn to it; and away he goes at second speed, clearing the lower bushes; and soon is close enough to solve the mystery. It is like the moon on the ground, a mass of brightness; and big living creatures are moving or lying about it.

He slowly comes nearer and is more fascinated. He gazes and comes still closer, is forgetting all sense of danger, when his eye catches a huge creature like an overgrown Coyote. It is gazing at the bright wonder. Dipo crouches under the nearest tussock; and, as he does, his nose is regaled with a strange, delicious smell. With eager snout and paws, he senses it, and finds that the odour comes from a big, soft seed that has no husk. Its taste is as delightful as its smell. He eagerly crams his pockets full. Then, by chance, the Coyote-creature rises, and rambles toward him. A sense of danger breaks the spell of the blazing wonder. Dipo turns, and lightly hops away, till all sign of the red splendour is lost.

Now a distant rumble, a drumming made by some kinsman's foot, warns him to "look out." On the ground, under a prickly thorn, he sinks down—a mere sand-bump on the sand. There is a slight swish, and the form of a Desert-fox, immense in the dim sage, glides through the opening and goes on.

With easy hops of half a yard, the Jumper heads upwind for a while, to get off the Fox's beat. Then, across an open space, he catches a flash of white—friend or foe? In the desert, mostly foe. Again the flash, a white lantern swung like a yardsman's bull's-eye, in a great half-circle—the national sign of his own people—the white tail-tip swung to let the other know. He swings his own tail, then stamps. The answer comes—the same. He rubs his back-pad on a low limb, then goes, rabbitlike, around; the other does the same. Thus they change places. Each smells the new-rubbed place. Then they surely laugh—for they are mates. Dipo hops up to his wife, they twiddle whiskers, lick lips, and rub cheeks in friendly salutation.

Thus they live their merry, thoughtless lives—not less merry for the nightly zest of risk. Harmless and helpless as baby Cottontails are these sleek sand sprites, absolutely ignorant of teeth or claws as weapons, for defense against carnivorous foes. Blossoms born on the idyllic desert life are they, embodiments of its delicacy and peace; even as the trumpet flower is the final product of the long-grown vine, and in itself expresses the powers and good things both of the plant, and of the mothering world about it.

But they have numerous foes to take advantage of their innocence. For these, what can they do? They have a ready answer; and not less than once or twice each night of life, they must offer it; that is, their matchless speed.

Even as the pair caress and frolic on the sand, they hear the grind of heavy feet—a sniff, and from the near sage, springs a Coyote, big enough to block the sky, and swifter than an owl. He is on them almost before they can move.

She bounces backward, darting under the monstrous enemy; he leaps under a friendly bush. Alas, it is only a grass tussock. The Coyote knows it, and lands on top; but Dipo jumps, eludes him, and springs away. Now it is a race on the open plains; and here we see how the Jumper can bound. Three feet in the air, five feet at a bound, five bounds to the second, he goes, the Coyote close behind at first. But the big brute's weight compels him to go fairly straight, while Dipo strikes a new, sharp angle at nearly every jump—here, there, back and forth, but headed ever for home. In all the darkness of the night, and the sameness of the sage, he never misses his home way. The Coyote races and follows for a hundred yards, then loses sight of the Jumper, who, wisely refraining from any high hop now, goes skipping like a Cottontail under the brush and cactus, till the foe is left far behind. Then, slowing down to his foraging gait, without landmark or spy-hop for observation, he reaches home unerringly. Kind Mother Nature has given him in his head, a gyroscope that guarantees the course.

On the edge of the tall timber, ten hops from the den, he halts, thumps with his hind feet, writes his name on a low limb with the ink-pad on his back; looks well around, then swiftly hies him to the doorway, and enters. No, his wife is not there! He closes the door by scratching back the sand. He empties out his cheek-pouches in a storeroom, and has a quiet bite before retiring.

Every night of their lives they have some such adventures as these; so he is not worried about his wife; he knows she can take care of herself.

He curls up to sleep, to be awakened presently by a scratching sound outdoors. He runs to the hallway, thumps two or three times with his hind feet. The signal is answered. He digs on the inside, the other digs on the out. His wife comes in. They twiddle whiskers, and lick lips. Now they close up the door with sand; then curl up together to sleep in peace far underground in their cozy bed of chewed-up yucca fibre.

References

1905—Biological Survey of Texas, by Vernon Bailey, N. A. F. 25, pp. 147–52.
1906—California Mammals, by Frank Stephens, pp. 156–58.
1922—Dipo, Sprite of the Desert, by Ernest Thompson Seton, Century Magazine, Nov., pp. 106–15; 8 ills. by the author.
1923—Sources of Water Supply for Desert Animals, by Vernon Bailey, *Scientific Monthly*, pp. 66–86, Vol. XVII, No. 1, July.

LIFE LXXXV—THE BEAVER

PAGE

Names 443
Description: Size, Weight, Colour, Colour Freaks 443
Races 444
Primitive Range and in 1910 445
Primitive Numbers 447
Haunts and Home Range 448
The Old-time Trapper 448
Present Numbers in British North America 450
Summary of Recent Reports 450
Conditions in the United States 451
Estimated Numbers in U. S. and Alaska 453
Material Contributions 454
Beaver Farming 454
Dams and Damage 455
His Tools 457
Cutting Down Trees 458
The Dam 460
The Dam-wise Beaver 461
Dam Stuff 463
Dam Dimensions 463
Landing Places 465
The Canals 466
Beaver Burrows 469
The Beaver Lodge 470
His Home Layout 471
Powers, Speed, Etc. 472
Diving for Distance 472
Mating and Breeding 473
The Kits 474
The Father 476
Outcast or Bachelor 476
The Sociable Workers—Signals 478
Curiosity and Tolling 480
Mud-pies 480

PAGE
Play 482
Food of the Bark-eater 483
Storage 484
The Wits of Amik 485
Responding to Sanctuary 488
Once More Diurnal 488
Disease and Age 489
Sanitation and Scats 490
Furred and Feathered Foes 490
Lice and the Louse-trap 493
The Beaver's Little Brother 495
To Scatter a Mob 496
As an Irrigator 496
Beaver and Trout 497
The Chain 498
The Moated Castle 498
Place in History 499

References 500

Beaver using his
Tail as a Trowel

Canadian Beaver, American Beaver

Castor canadensis Kuhl

(L. *Castor*, a Beaver; L. *canadensis*, of Canada)

Castor canadensis KUHL, 1820, Beiträge z. Zool., p. 64.

TYPE LOCALITY—Hudson Bay

FRENCH CANADIAN, *le Castor*.
CREE, *Ah-misk'*.
OJIBWAY, *Ah-mik'*.
CHIPEWYAN, *Tsa*.
YANKTON SIOUX, *Tcha-pá*.
OGALLALA SIOUX, *Chan-pah'*.

The Family *Castoridæ* contains but one genus, *Castor* (Linnæus, 1758); the animals in this, are very large rodents of aquatic habits. They have a massive skull of general squirrel type; short ears; 5 toes on each foot; the hind foot webbed; the claw of second toe on hind foot is double (possibly for use as a comb and louse-trap); tail, broad, flat horizontally, and scaly; the incisors, of a deep, orange colour.

$$\text{Teeth: Inc. } \frac{1-1}{1-1}\text{; prem. } \frac{1-1}{1-1}\text{; mol. } \frac{3-3}{3-3} = 20$$

When alive, the Beaver looks like a huge Muskrat; but the broad, flattened tail is a distinctive mark at all ages.

Dugmore says: "Outwardly, there is nothing to distinguish the sexes, except when the female is suckling her young; then her 4 teats, which are situated between the forelegs, are slightly enlarged."[1] Richardson says: "The female has 8 teats."[2] But C. E. Johnson says "4 is normal."

In addition to the generic characters, the Canadian Beaver has:

Size. Length, 43 in. (1092 mm.); tail, 16 in. (406 mm.); of which the scaly part is 9 in. (229 mm.) long, and 4½ in. (115 mm.) wide; hind foot, 7 in. (177 mm.).

---

[1] Romance, p. 213.

[2] F. B. A., I, p. 107.

Weight. A male which I got near Great Slave River, July 11, 1907, weighed 30 lbs.; this was considered of fair size.

William H. Blackburne, of the Washington Zoo, tells me that, about 1904, he received 10 Beavers, captured alive in Yellowstone Park by T. Elwood Hofer. Of these, the heaviest was 56 lbs.; another was 42 lbs.; the rest ran from 34 to 38 lbs., and were probably two-year-olds.

At Winnipeg, in 1886, I saw one weighed at 54 lbs.; this was taken at Brokenhead, Man. Although Bachman gives[3] 61 lbs. as a maximum, W. R. Hine tells me that he weighed a 68-lb. Beaver that came from Port Arthur, Ont.

"Old and large Beavers reach a weight of 60 to 70 pounds; and there are records of old and very fat Beavers weighing from 100 to 110 pounds."[4]

Colour. The general colour is a deep, dark chestnut; darker on the ears; paler and grayer below; the cheeks, pale brown, in contrast with the crown; the region above and at each side of the tail, cinnamon rufous or bright chestnut.

The sexes are alike in colour.

Colour Freaks. Both black and white freaks are found. The black pelts are worth about double the common ones; the white ones have no especial value.

"Black Beaver," says Hearne, "and that of a beautiful gloss, are not uncommon; perhaps they are more plentiful at Churchill than at any other Factory in the Bay; but it is rare to get more than 12 or 15 of their skins in the course of one year's trade."[5]

The Canadian Beaver differs from that of Europe chiefly in being much larger, and in having shorter nasal bones. Those bones in the European measure *considerably more than one-third* the distance between the incisors and the occipital crest, and in the Canadian *about one-third.*

RACES

The following races of *canadensis* are recognized:

- *canadensis* Kuhl, the typical form. T. l., Hudson Bay.
- *carolinensis* Rhoads, larger than the type, with broader tail. T. l., near Danbury, Stokes Co., N. C.
- *frondator* Mearns, larger and paler than the type, with scaly part of tail shorter than twice the width. T. l., San Pedro River, Sonora, Mex.

---

[3] Q. N. A., I, p. 353.

[4] V. Bailey, Beaver Farming, p. 4.

[5] Journey, p. 241.

leucodonta Gray, largest and (except phæus) darkest of all, with scaly part of tail longer than twice the width. T. l., Vancouver Id., B. C.

texensis Bailey, very large and pale, with scaly part of tail longer than twice the width. T. l., Cummings Creek, Colorado Co., Tex.

shastensis Taylor, much like *subauratus*, with broader interparietals, and other cranial differences. T. l. Cassell, Pitt River, Calif.

subauratus Taylor, a large form, lighter in colour than *leucodonta*, but not so light as *frondator;* with a golden sheen over the body. T. l., Grayson, Stanislaus Co., Calif.

missouriensis Bailey, slightly smaller than *canadensis;* much paler and duller brown, and with skull less massive; duller and darker than *mexicanus;* not so rusty as *frondator*. T. l., 7 miles east of Bismarck, N. D.

belugæ Taylor, like *leucodonta*, but paler; pelage thicker, also with cranial distinctions. T. l., Beluga River, Cook's Inlet, Alaska.

mexicanus Bailey, brighter and lighter than *missouriensis*. T. l., 6 miles below Ruidoso, Lincoln Co., N. M.

michiganensis Bailey, size medium or small; colours very dark; ears and feet black; skull short and quadrate. T. l., Tahquamenaw River, Luce Co., Mich.

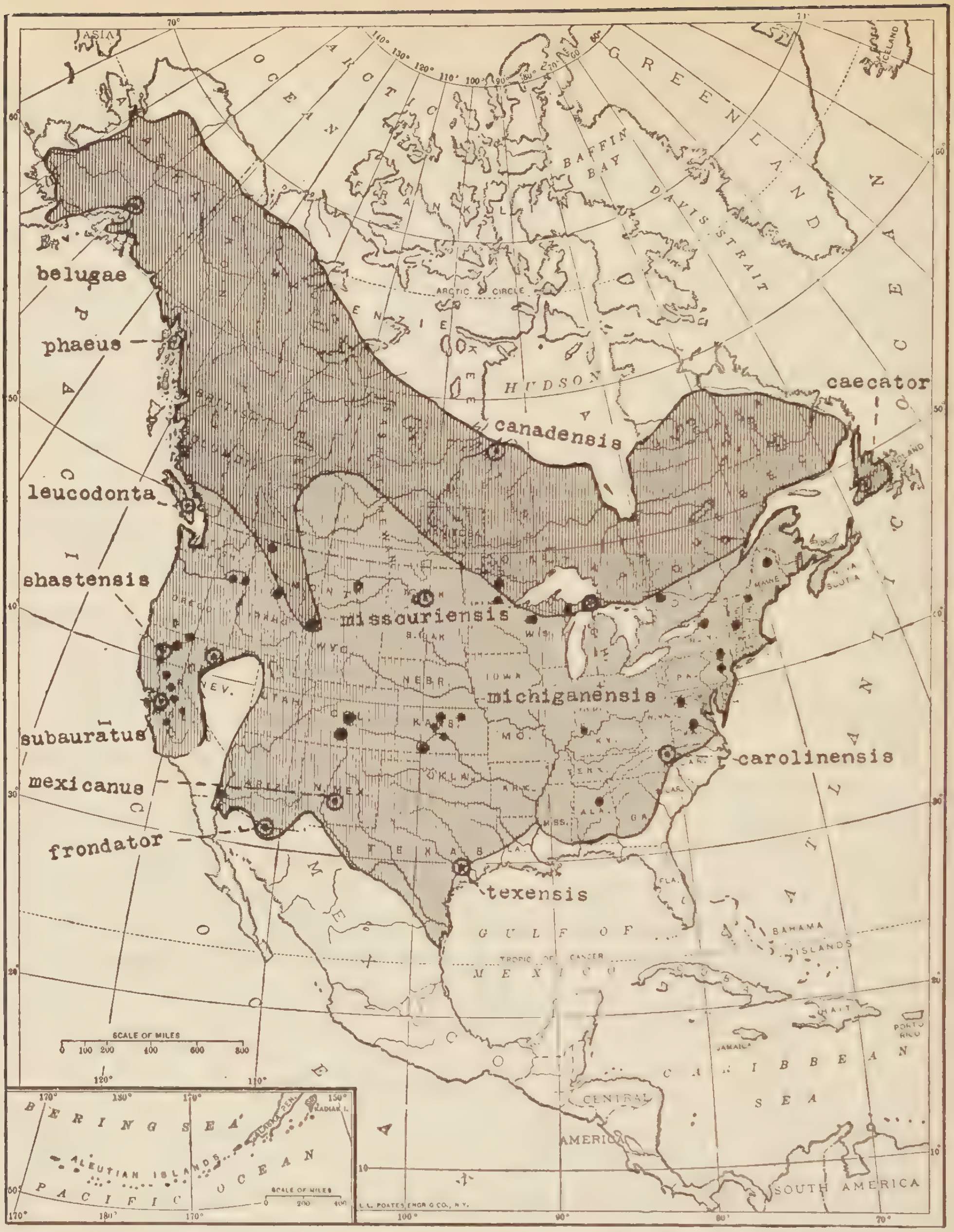
phaeus Heller, colour above, dark seal-brown; very much darker than *leucodonta*. T. l., Pleasant Bay, Admiralty Id., Alaska.

caecator Bangs, like *canadensis*, but slightly smaller, and with cranial differences; incisors yellow instead of orange. T. l. near Bay St. George, Newfoundland.

PRIMITIVE RANGE AND IN 1910

Map XIII (*page 446*) shows that the Beaver ranged over all temperate America, wherever there was wood with water. Nevertheless, it abounded chiefly in those areas where the aspen, its favourite food, was found in abundance.

In 1900, after four centuries of unrestricted and wholesale slaughter, there were great blank spaces on this Map. In practically all of the United States, the Beaver were killed off. A few small regions still held a remnant; among these were Maine, Minnesota, and the Rockies in Wyoming, Montana, and Idaho.



MAP XIII.—RANGE OF THE BEAVER

By E. T. Seton, with assistance of the Biological Survey, 1927

The original range is the tinted area. In Canada and Alaska, it is still of general distribution, as indicated by heavy shading, excepting on the Ontario Peninsula, and the prairie region of Manitoba, Saskatchewan, and Alberta.

In the United States, it is extirpated except in a few scattering remnants. Those known as exact records in 1925 are entered as dots on the map of the U. S.

Beaver, thus virtually restricted to Canada, were found sparsely over all the ancient range there, excepting on the Ontario Peninsula.

W. Couper holds that Beaver never were found in Anticosti.[6]

PRIMITIVE NUMBERS

Harry V. Radford, after much investigation, set the primitive Beaver population of the Adirondacks at 1,000,000, or about 60 to the square mile. The Adirondacks is about one four-hundredth of the total range, and was choice region. Vast areas, like the Mississippi Valley, were so poorly peopled that the figures might be divided by 10. So that these data imply a pristine population of 400,000,000.

Approaching the question in another way: In the late '50's, L. H. Morgan explored thoroughly a Beaver country on the southwest shore of Lake Superior, immediately west of Marquette; it was 6 by 8 miles. In his map[7] of this, he shows 63 dams and 39 lodges. Each lodge was estimated to represent 7 Beaver; that is, 273 in all, or $5\frac{2}{3}$ to the square mile. But he mentions that not all of the lodges are shown on the map. A reading of the text leads us to believe that there were twice as many as marked; so that his ratio may have been 10 to the square mile. Any of us that are familiar with Beaver country, know that 20 to the square mile would not have been an overestimate in such surroundings.

In Cochetopa National Forest, the Beavers have been computed at 12,000. The Forest is 1,400 square miles. This gives over 8 to the square mile; but we are told that but half of the productive area is in use;[8] which would raise the rate to 16 per square mile.

The Plains were less attractive to the Beaver than the mountains, and the Mississippi Valley no better than the Plains. On the other hand, the great poplar country of the North teemed with Beaver; and the ratio supplied by Morgan's data of 10 to the square mile in Minnesota, may easily have held as average, on the greater part of the range. That range was about 6,000,000 square miles, so that 60,000,000 may have been the primitive Beaver population in years of abundance.

That these figures are not too high, is shown by the Beavers in Algonquin Park, Ont., which comprises nearly 2,000 square miles. Dr. T. S. Palmer tells me that the Beaver there are estimated at 100,000, or 50 to the square mile. This represents maximum abundance.

---

[6] Forest & Stream, June, 14, 1877, p. 300.

[7] Am. Beaver, p. 82.

[8] Adirondack Beaver, p. 168.

But, supposing such conditions prevailed on only one quarter of the Beaver range, it would imply a total population of about 100,000,000 Beaver. I, therefore, hold that the above 60,000,000 estimate is a safe and conservative computation of the population in primitive times.

Haunts and Home Range

Sluggish streams and small lakes with clay banks that are well wooded with aspen and willow are the favourite haunts of the Beaver. Streams that run in rocky beds, or that dry up in summer, and large rock-bound lakes are equally shunned.

The individual range is very small for so large an animal. When the pair have found and settled in a place that suits them, they do not travel half a mile from home. When, on the other hand, an unmated Beaver is seeking a partner or a good location, he may wander for a dozen miles.

During the summer, the old males and the weanlings often leave the mother and kits on the home pond, and go on a camping trip that may last all summer, and take them 20 miles away. But all return to the central lodge in early autumn.

At the Big Dam Lake, 40 miles east of Kippewa, Que., on Sept. 21, 1905, I saw much Beaver work, and learned from Mittigwab, the Indian guide, that all of this was the work of one old male Beaver that had lived here alone for two or three years. He wandered as much as 15 miles up stream from the Lake, and 1½ miles from water, in search of company, especially in early spring when the ice first breaks up.

The Old-time Trapper

Some idea of the vast numbers of the Beaver may be gathered from the following records:

In 1825, James O. Pattie, trapping on the San Francisco River of Arizona, caught 250 Beaver in two weeks.[9]

Alexander Ross, in his "Fur Hunters of the Far West," (1855) says of the trapping on the Continental Divide that is in the Bitterroot Mts., between the Missouri and Columbia Rivers: "While in the last defile, we took 95 Beaver in one morning, and 60 more during the same day."[10] In summary, he states that he had 212 Beaver traps, and that at the close of the season (1823–24), "our returns were the most profitable ever brought from the Snake country in one year, amounting to 5,000 Beaver, exclusive of other peltries."[11] That is to say, his 20 trappers averaged 250 Beaver each, in spite of continual trouble with the Indians.

---

[9] Personal Narrative, 1905 ed., p. 56.

[10] Vol. II, p. 53.

In 1850, Audubon and Bachman wrote of the Rocky Mountain trapping: "A good trapper used to catch about 80 Beavers in the autumn, 60 or 70 in the spring, and upwards of 300 in the summer in the mountains; taking occasionally as many as 500 in one year. . . . If a trapper now secures 100 in the winter and spring hunt, he is considered fortunate."[12]

George P. Belden, who lived with the Sioux in the '60's, says: "A trap weighs about 5 pounds, and it is considered a good load to carry 12. It will require a walk of 10 or 12 miles, and all of one day, to set a dozen traps properly. If 3 Beavers are caught each night for every dozen traps set, the trapper considers he is doing a good business. . . . During the winter season, the hunter will average not over 4 Beavers per week, for there are many days he cannot trap."[13]

Henry Bannon, in his "Beaver Days," says: "A trapper with 25 traps on his line, must make his rounds; must reset sprung traps, and must establish new locations. Two Beaver a day from such a line is an excellent average."[14]

Something like a restoration of primitive conditions is noted in the official report of Beaver in Cochetopa National Forest. Here, after some years of protection, the Beaver have increased to 12,000 on the 1,400 square miles of the Forest; that is, over 8 to the square mile. Here, in one month, one Government trapper, with 20 traps, caught 132 Beavers.[15]

At one time the last quarter of the 18th Century—about 150,000 skins were exported annually by the American companies, besides which the Hudson's Bay Company marketed about 50,000 per annum.

In 1891, the American supply had dwindled to 11,693, and the Hudson's Bay Company's was 57,260—a bad year for the Company, as in 1887, its export had been 102,745, and in 1871, had reached 174,461.

In 1924, the total catch in Canada was 169,172 pelts, with probably enough in Alaska and the United States to make the round 200,000. It is very doubtful whether they can stand such a drain.

In 1905, the latest year for which I have complete figures, the Hudson's Bay Company's returns were 54,119.

At the London annual fur sales held at Lampson's (March, 1906), 8,414 Beaver were sold. The highest price reached was 62 shillings ($14.88) each, for 41 first-class black skins; 30 shillings ($7.20) to 35 shillings ($8.40) were ruling prices for first-class skins, from which they graded down to about 15 shillings ($3.60) for thirds.

---

[11] Vol. II, pp. 140–41.

[12] Q. N. A., I, p. 354.

[13] Belden, the White Chief, 1872, p. 136.

[14] Days, p. 513.

[15] Smith Riley, Journ. Mamm., Nov., 1921, p. 201.

During the great fur boom of 1920, the average price paid for Beaver was $16.31. The record price was $100.

The average annual total of Beaver skins brought out by the American fur companies and the Hudson's Bay Company for the period between 1860 and 1870, when the fur trade was at its height, is, in round numbers, 153,000. But the natives used as many good pelts as they sold, and seldom saved the skins of those taken in summer, though they killed for food the whole year round. So that 500,000 per annum is more likely to represent the aggregate destruction by man. This was at least doubled by other agencies. and the total annual death rate would reach not less than 1,000,000.

Present Numbers in British North America

The tremendous slaughter of the Beaver through the general use of steel traps and modern guns, combined with the reduction of the range by clearings, brought the usual change. The species disappeared from the immediate Mississippi Valley and all the Eastern States except Maine. The southern parts of Quebec, Ontario, Manitoba, Saskatchewan, and Alberta were wholly cleared of Beaver. The low dip of the curve was the dark time about or right after 1895; perhaps 1900 was the blackest year of all.

Then came the awakening, which took the practical form of protective laws, sanctuaries, and implantations.

Summary of Recent Reports

Newfoundland. The Beaver here was reduced to a remnant in 1900; but, thanks to a protective law, they are slowly increasing. Dugmore says that during his visits to the Island in 1901–05, he "*never saw but one Beaver colony*, and that, a very small one in a remote and inaccessible part of the country. In 1912, I counted no less than 27 occupied lodges within a short day of walking and canoeing."[16]

Quebec. Rapidly recovering.

Ontario. Recovering. The Algonquin Park had but a remnant 25 years ago; now (1922) it is believed to carry 100,000 Beavers—which are overflowing and restocking the adjoining country.

Manitoba. In 1900, the Beaver was practically extinct; but in 1924, according to George H. Measham, of the Winnipeg *Tribune*, 5,000 pelts were marketed, and there were plenty of Beaver left for seed.

---

[16] Romance, p. 159.

From *Saskatchewan*, *Alberta*, and *British Columbia* also come encouraging reports.

The official returns of Beaver pelts taken in Canada during the seasons 1920–21 to 1923–24, are 164,656; 232,134; 175,275; 169,172. Allowing for kits, poor skins, local absorption, and free traders' furs, these figures imply a destruction of 300,000 a year in Canada; and, because the stock increases, it indicates a total of at least 1,500,000 Beaver in the Dominion to-day.

CONDITIONS IN THE UNITED STATES

The wipe-out was more nearly complete in the United States. The scattered fugitives in the remote swamps of the Northwest and the Rockies were shyer than ever before. They never appeared in daylight; and but for their dams, might have eluded notice.

New York. The first notable restoration was in the Adirondacks, where, in 1904, under management of Harry V. Radford, 6 Beavers were introduced; other implantations (35 Beaver in all) were made later.[17]

In 1908, these, with a possible dozen of the original population, had increased to 150. In 1920, according to Dr. C. E. Johnson, they had reached 8,000.[18] In 1924, an open season was declared, and about 5,000 pelts taken. In 1925, the same law and results were repeated. So that, in 1926, the number of Beaver in the Aidrondacks was probably not more than 10,000.

Sullivan Co., N. Y. Ambrose Monell planted 8 Beaver in Bushkill on his estate. This was in May, 1914. They are thriving, and spreading,[19] and are now estimated at 100.

Vermont. An implantation of 6 was made at Stamford, Bennington Co., in 1921.[20]

New Hampshire. "Two colonies in the northern part of Coos Co."[21]

Maine. Generally distributed, but rare; increasing under protection.

New Jersey. About 1900, some Beaver on Rutherford Stuyvesant's Game Preserve at Allamuchy, N. J., escaped, and have spread over parts of Sussex Co.[22]

Pennsylvania. In Monroe Co., after being totally extirpated for 50 years, Beaver reappeared in 1901. They are being carefully protected.[23]

---

[17] See N. Y. S. F. F. & G. Comm., 12th Ann. Rep., 1907, p. 41.

[18] Adir. Beaver, p. 165.

[19] N. Y. Zool. Soc. Bull., Nov., 1915, p. 1296.

[20] George L. Kirk, Journ. Mamm., Feb., 1923, pp. 59–60.

[21] C. F. Jackson, Journ. Mamm., Feb., 1922, p. 15.

[22] S. N. Rhoads, Mamm. Pa. & N. J., 1903, pp. 76–77.

[23] As above, p. 70.

John J. Slautterback, of the Game Commission, writes me (Dec. 14, 1926) that about 30 counties of Pennsylvania now have Beaver colonies—at least 150 colonies in all. This, I take it, means not less than 3,000 Beaver in the State.

Virginia. In *Forest & Stream* for March, 1915, p. 229, is an interesting statement by T. Peter Howle, of Richmond, Va., that a colony of Beaver has appeared in the upper part of the James River, after a 50 years' blank.

West Virginia. A colony of immigrants appeared in the fall of 1922 at Tear Coat Creek, an affluent of the North River.[24]

Kansas. Although wholly gone in 1900, Beaver have reappeared on Blue, Solomon, Smoky Hill, Mulberry, and Arkansas rivers.[25]

Minnesota. In Itasca Park, a few Beaver were found in 1900; elsewhere in the State, there were none, except a scarce remnant in Lake, Cook, Beltrami, Koochiching, and St. Louis counties. Protection and restocking began. In 1924 not less than 1,200 were in the Park.[26] They are also numerous now in Lake Co.[27]

In the northern tier of States, west of Minnesota, a few Beaver managed to hold out till 1900; then, in the awakening, they increased.

Wyoming. In Yellowstone Park, according to a recent letter from E. J. Sawyer, "800 would be a reasonable estimate of the present Beaver population."

Washington. Common now and troublesome in the southeast corner of the State.[28]

Oregon. "Oregon has already obtained marked success in starting new colonies in different parts of that State."[29]

California. New colonies possessing the desolated ranges are reported from Modoc Co.,[30] Sacramento, San Joaquin, Pitt, Merced, Tuolumne, and Stanislaus rivers.[31]

About "100 Beavers in the Imperial Valley."[32] Since protection, they have "increased greatly."[33]

---

[24] A. B. Brooks, Journ. Mamm., Aug., 1923, p. 191.

[25] N. Y. Zool. Soc. Bull., May, 1924, p. 71.

[26] Hunter-Trader-Trapper, Nov., 1924, p. 33.

[27] C. E. Johnson, Journ. Mamm., Feb., 1922, p. 36.

[28] L. R. Dice, Journ. Mamm., Nov., 1919, p. 19.

[29] Cal. F. & G., Oct., 1915, p. 222.

[30] As above, July, 1916, p. 163.

[31] W. P. Taylor, Conservation of Native Fauna, Scientific Monthly, Oct., 1916, p. 401.

[32] J. Dixon, Journ. Mamm., Aug., 1922, p. 140.

[33] H. C. Bryant, Cal. F. & G., Oct., 1915, p. 236.

ESTIMATED NUMBERS IN U. S. AND ALASKA

From the annual report of the Forester[34] for the year ending June 30, 1926, I quote the following statistics of Beaver in the National Forests, by actual census of Dec. 31, 1925.

Arizona	185	
California	271	
Colorado	47,314	
Idaho	12,208	
Minnesota	2,708	
Montana	15,383	
New Hampshire	180	
Nevada	662	
Oregon	5,849	
So. Dakota	2,176	
Utah	9,687	
Washington	11,138	
Wyoming	6,563	
Total		114,324
Add half as many more outside of the Forests, but protected by State laws		57,162
Add to this, the States not listed. These are estimated as follows:		
Kansas	100	
Maine	5,000	
Michigan	2,000	
New Jersey	100	
New York	10,000	
No. Dakota	2,000	
Pennsylvania	3,000	
Vermont	100	
Virginia	10	
West Virginia	10	
Wisconsin	100	
Total		22,420
Alaska		50,000
Scattering in these and other States		8,094
Total in U. S. and Alaska		252,000

---

[34] U. S. Dept. Agri., p. 37.

Commenting on the figures above, Will C. Barnes says:[35] "The Service estimates that, in addition to the number of Beaver in the National Forests, probably half as many more are to be found on streams outside the National Forests where they have been protected by State laws." This proportion is added in the census above.

Material Contributions

This animal has always been a staple of food and raiment to the natives of America. Its wonderful coat of fur is prime for half of the year, it is backed by a very strong skin, and is one of the peltries most highly prized.

The skin of its tail has provided ornamental leather for pouches and purses; and there is always a possibility that, in the description given later, of its split toenail, our settlement workers may be inspired to discover a new and comforting suggestion. (See Section on Parasites.)

As a food supply, the Beaver takes a prominent place. The flesh is good, and the tail is considered a delicacy. In taste, it is like calf's head with marrow-dressing, is decidedly rich and heavy, but I found it delicious eating.

Richardson says: "The flesh of the Beaver is much prized by the Indians and Canadian Voyagers, especially when it is roasted in the skin, after the hair has been singed off. In some districts, it requires all the influence of the Fur Trader to restrain the hunters from sacrificing a considerable quantity of Beaver fur every year, to secure the enjoyment of this luxury; and Indians of note have generally one or two feasts in a season, wherein a roasted Beaver is the prime dish."[36]

In a vast portion of the Mackenzie Valley, the Beaver serves the Indians as the Buffalo did those of the Plains. It is their staff of life, it feeds and clothes them, as well as supplies the necessary peltry to barter with traders for other things desired. These tribes are very naturally known as the "Beaver Indians."

Beaver Farming

With the choice Beaver pelts fetching as high as $100 apiece during the great fur boom of 1920, one is not surprised to hear of many attempts at Beaver farming. In general, one may say that, so far, no one has made a success of it when tried on a small scale, such as a 50-acre plot; and that no one has made a failure of it when tried on a large scale, such as 1,000 square miles, with adequate protection.

Illustrations in point are the Cochetopa Forest, 1,400 square miles,

---

[35] Personal letter, Dec. 16, 1926.

[36] F. B. A., I, pp. 106–107.

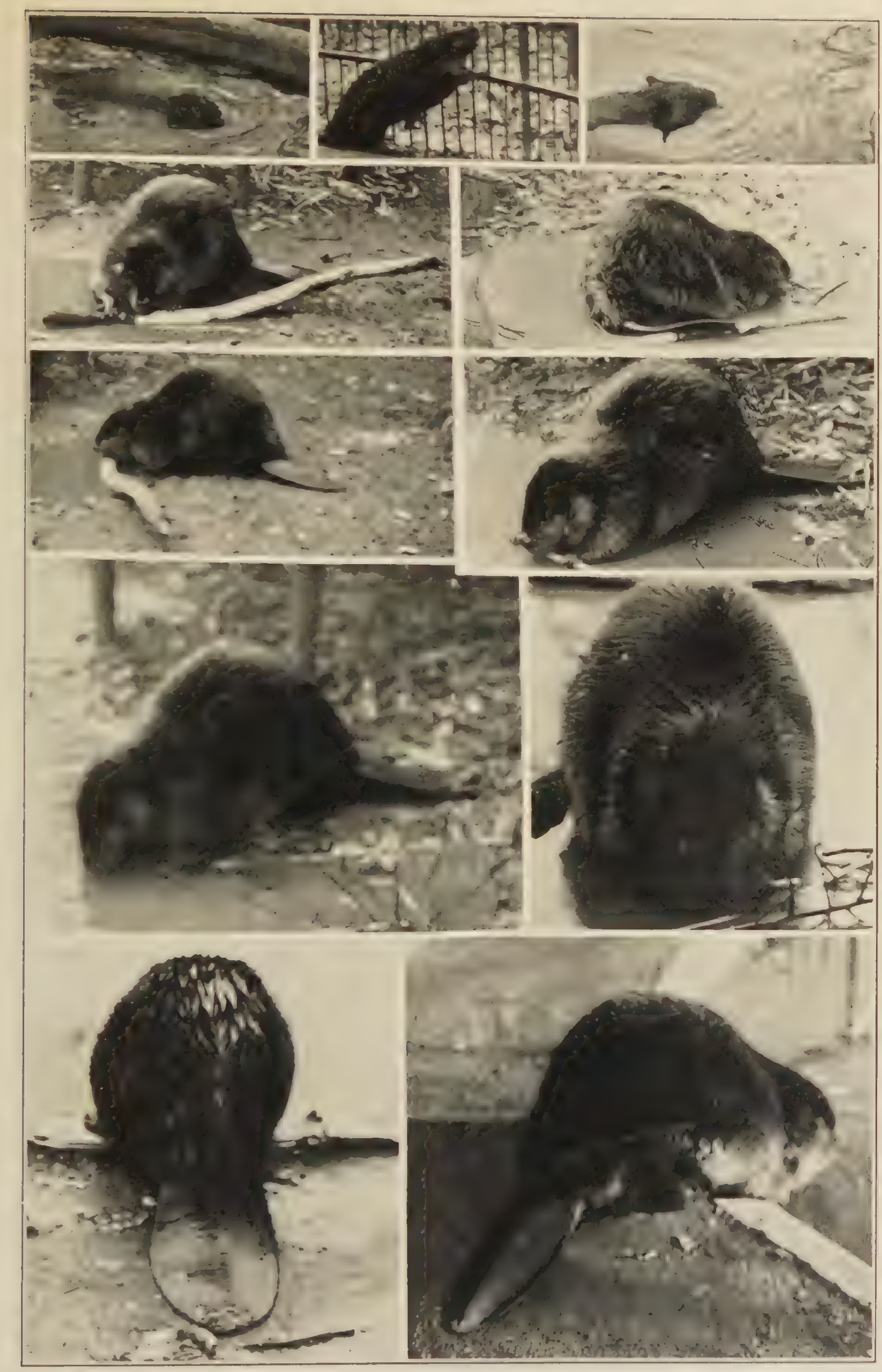


PLATE LXI.—BEAVERS IN WINNIPEG ZOO

The lowest figure at the left shows a Beaver carrying mud on its tail
Photographs by E. T. Seton

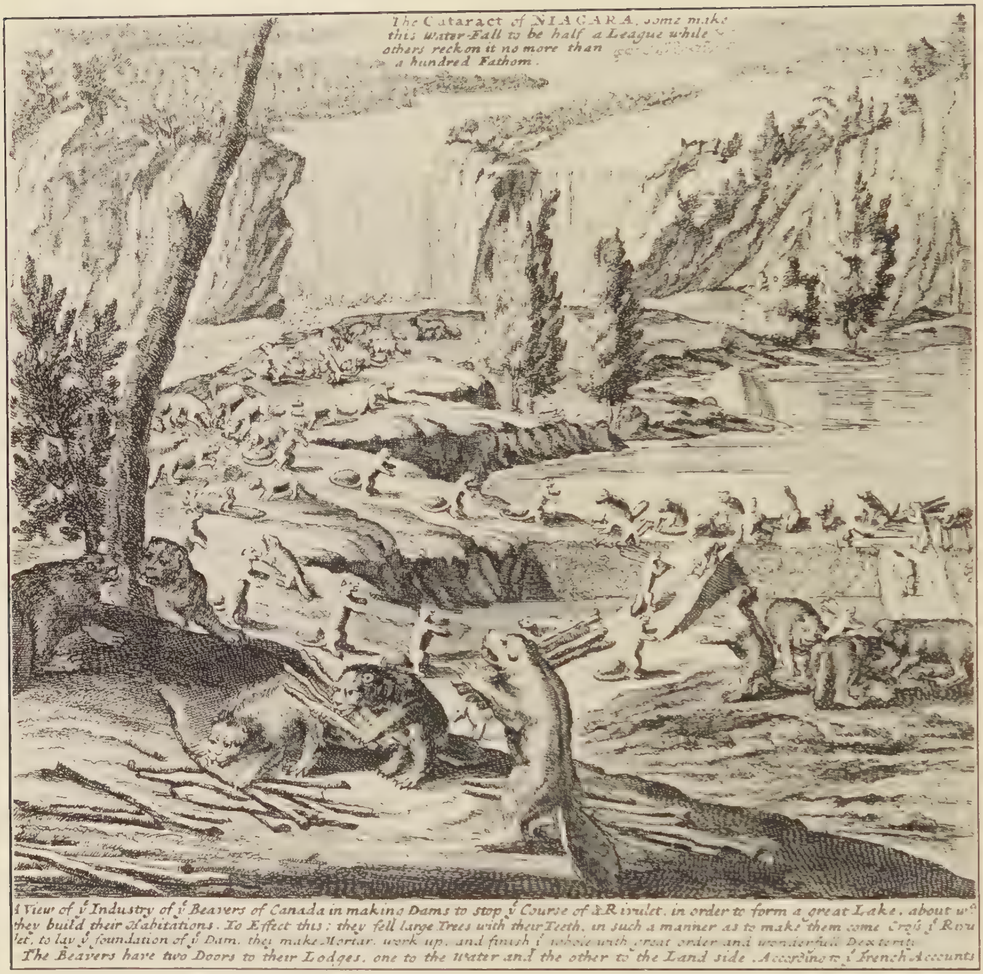

The Cataract of NIAGARA, some make this Water-Fall to be half a League while others reckon it no more than a hundred Fathom.
A View of yᵉ Industry of yᵉ Beavers of Canada in making Dams to stop yᵉ Course of a Rivulet, in order to form a great Lake, about wᶜʰ they build their Habitations. To Effect this; they fell large Trees with their Teeth, in such a manner as to make them come Cross yᵉ Rivulet, to lay yᵉ foundation of yᵉ Dam, they make Mortar, work up, and finish yᵉ whole with great order and wonderfull Dexterity.
The Beavers have two Doors to their Lodges, one to the Water and the other to the Land side. According to yᵉ French Accounts

PLATE LXII.—OLD PRINT OF BEAVERS

This old plate embellishes a map of the British Dominions in North America, 1715. It portrays current notions anent the beaver, and is also the earliest known picture of Niagara Falls now carrying 12,000 Beaver, rapidly increasing; the State Forest Reserve in the Adirondacks (chiefly in Herkimer and Hamilton counties), 3,200 square miles, with 10,000 Beaver, rapidly increasing; and the Algonquin Park, 2,000 square miles, with 100,000 Beaver, which might easily yield a Beaver crop of 10,000 per annum.

Here, the wide-awake Canadian Government has proceeded to demonstrate the possibilities of Beaver ranching. The pelts, on an average, are worth $15, according to present markets; and the excellent meat, hitherto wasted, is now being sold.

In *Field & Stream*,[27] we learn that "the provincial government of Ottawa shipped 600 Beaver from Algonquin Park to the civic abattoir at Toronto, where they were dressed and distributed to retail dealers for the Easter trade. They sold at 18½ cents per pound for a half carcass, and 17½ cents for the whole carcass."

DAMS AND DAMAGE

An unexpected jolt has been given the whole plan of Beaver restoration by the complaints of land and timber owners in the Adirondacks.

In *Field & Stream*[28] is given a summary of the Ranger's Report on Beaver dams in the Adirondack Forest Preserve, as follows:

Total number of dams reported	587
Total area flooded	8,681 acres
Total value of timber drowned	$51,425
Possible salvage of timber	$ 5,530
Average damage per dam	$ 90

Other charges against the Beaver are that it builds ponds that harbour pickerel, now prey on trout; it floods the marshes that once furnished winter forage for Deer; it comes up on private lawns and cuts down the choicest shade trees.

The answers are: The damage done by flooding is temporary; once a balance is established and a fair population provided for, flooding will cease.

Next, by conserving the water supply, the Beaver keeps little brooks running all year, instead of only during freshets, so that the forest is helped by irrigation. Its ponds provide valuable fireguards, far offsetting the timber damage by the flooding. It makes trout streams of many rills that were mere drains.

---

[27] Aug., 1918, p. 330.

[28] Nov., 1919, p. 386.

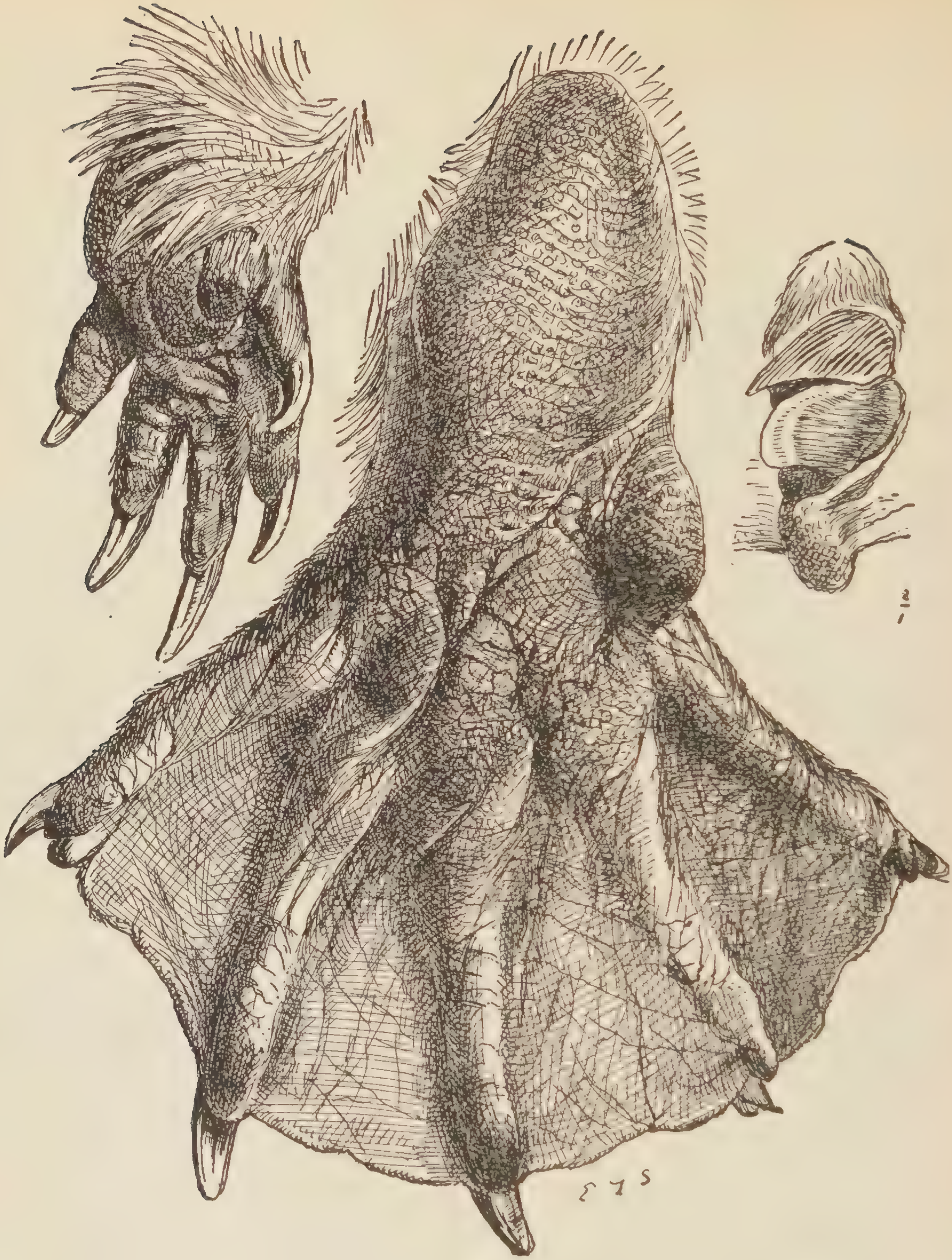


PLATE LIV.—FEET OF ADULT MALE BEAVER (LEFT SIDE), TAKEN NEAR FORT RESOLUTION, M. T., JULY 11, 1907.

Eleven-twelfths of life size. The figure in the right upper corner is the split nail of the second toe on hind foot; it is twice natural size

Marsh grass is not the winter forage of Deer; they prefer twigs. Private laws are easily protected with a low wire fence; and in all cases, the Beaver prefers quaking aspen, which is never planted as an ornamental tree.

Finally, it is a valuable animal, economically considered. The Adirondac Beaver, properly handled, may be, not merely a joy to the people who see them, but an annual profit of $100,000 to the State.

His Tools

Teeth. The four bright orange incisors of the Beaver are his chief tools in the battle of life. He could live without his tail, or his paws, or his hind feet—yes, even without his eyes. But without his four yellow wood-choppers, he would die in a week. With these, he stands on the highest pinnacle in the scale of rodents—the top of the pyramid on which these creatures might be exhibited in rising order of rodentation.

The fact that the incisors have persistent, fast-growing pulps, is emphasized in the following by Henry Braithwaite, who says: "One of the queerest facts about the Beaver is the rapidity with which his long, chisel-shaped teeth will recover from an injury. I have known Beavers to break their teeth in biting a trap; and when I caught them again ten days afterwards, you couldn't see a sign of the break—the teeth had grown out to their former perfection in that short period."[39]

An inevitable suite of such continuous growth is seen in cases where the Beaver breaks off one tooth so that its opposite has no counter-grind. It continues growing till it forms an arc, disabling and finally killing its unlucky owner. This curious accident has been recorded for many rodents.

Double Claw. The extraordinary double or combing claw that is found on the second toe of the hind foot is more fully discussed in the section on Lice and Louse-trap (p. 494).

Fore paws. Next to the four orange-yellow, self-sharpening wood-axes that he carries in his mouth, the important tools of the Beaver are his fore paws. Those marvellous little hands of his are the world's standard of indefatigable industry. Every gob of mud, every stick and stone in the dam or the lodge, is moved by those small hands. Sticks are held in them while being cut up by the teeth; mud and stones are clutched in them, against his throat or shoulder, to be transported; the Beaver pushes, pulls, digs, and grapples with them, scratches his back, combs his hair—uses them in all senses, indeed, as hands.

Long sticks are carried in the teeth, with the end over the Beaver's back, if on land. Small logs are rolled by one or more Beavers, pushing with their hands, their shoulders, their hips, or their whole broadside.

---

[39] Habits, p. 2.

Tail. At one time, inspired by the shape of the member, currency was given to an idea that the Beaver used his tail for a trowel. Circumstantial proof was found in the facts that loud slaps were heard, which certainly were made by the Beaver's tail; and impressions of the tail were sometimes seen in the new-laid mud. These, however, were easily explained away, and a rigid ruling made that Beaver do use the tail for swimming and signalling, but for nothing more.

A rigid ruling is always a challenge. The Beavers and the Beaver-men took it up. First, Josef Brunner not only sees, but secures a photograph of a Beaver actually carrying a bundle of food-wood across his tail, which was curled up high to hold it.[40] The accompanying article contains the following: "In handling the mud, however, the Beaver makes a pile with his front feet, turns around, forces his tail sideways into it, and then lifts this so that the load rests partly on it and partly on his back."[41]

Next, Major William A. Welch, of Interstate Park, N. Y., writes of the Beaver in his care.[42] "The other evening, I watched at Nawauhunta a Beaver come to the shore of the lake; and, with his teeth and his front feet, dig out about an ordinary spadeful of mud and grass roots from the edge of the bank. He drew this mud and grass roots out into the lake, where it was just covered with water, and then turned around and put his tail under the whole thing, just as you would a spoon, bent up the end of his tail to hold it on, and swam about 25 yards with this shovelful of mud on his tail, over to the dam, and placed it on the dam. He then drew his tail from under it, turned around, and started to put it into shape."

Finally, at Winnipeg, in the October of 1924, I myself succeeded in photographing a Beaver in the act of carrying some gravel on his tail. (Plate LXI p.494) It was not much, but enough to serve as a warning against hard-and-fast rules, too readily proclaimed.

Cutting Down Trees

The first original thing that the Beaver did, after he really became a Beaver, was to cut down a tree. This is one of the most amazing performances of the species; so, of course, it was much exaggerated in early accounts. Thus, the statement that the Beaver is so skilful that he can always throw the tree toward the stream, is quite misleading. He cuts, first, the trees on the margin; these always lean toward the stream, so must fall streamward. But later, when cutting farther afield, the trees as often go wrong as right. This I have often seen; and frequently, it has happened that some Beaver made a miscalculation, and was killed by the fall of his own tree.

---

[40] Country Life, April, 1904.

[41] P. 481.

[42] N. Y. Zool. Soc. Bull., Nov.-Dec. 1926, XXIX, No. 6, p. 210.

The largest trunk I have ever seen cut down by Beavers was 14 inches in diameter—this was a quaking asp; but we have records of cottonwoods 20 and 24 inches; 30 inches;[43] and nearly 3 feet.[44] Mills says: "The largest Beaver cutting that I have measured was a cottonwood with a diameter of 42 inches."[45]

These, however, are exceptional; 3 to 8 inches is the usual run. At one Beaver cutting, I counted 116 poplar stumps; there were 6 such places near the dam. The largest stump of all was but 8 inches through.

Many observations lead me to say that a Beaver can cut down a tree about as fast as a man could do it with a rather dull hatchet. Two Beavers can fell a 3-inch sapling in 3 minutes, and a 6-inch tree in an hour or two. On Dec. 6, 1919, Dr. Raymond T. Ditmars showed me a movie of a Beaver cutting down a tree in the Zoo. It was a 4-inch hardwood, and took but 15 minutes to fell. The Beaver plunged into the water as the tree went down.

The work of felling is usually done by the pair, with assistance at times from their grown-up children.

Three are the most that have been seen working on the same tree at once. "With this number," says Morgan,[46] "two nights at most would give ample time to fell a tree a foot in diameter." A party of surveyors in the Beaver country near Marquette "counted 19 tree-falls which they heard in a single night between the hours of 7 and 12 o'clock."[47]

The same observer gives the following interesting description of the felling:[48] "When but two are engaged, they work by turns, and alternately stand on the watch, as is the well-known practice of many animals while feeding or at work. When the tree begins to crackle, they desist from cutting, which they afterward continue with caution until it begins to fall; when they plunge into the pond, usually, and wait concealed for a time, as if fearful that the crashing noise of the tree-fall might attract some enemy to the place.

---

[43] Am. Beaver, p. 177.

[44] Lewis & Clark, Longman's ed., p. 146.

[45] Watched, p. 56.

[46] Am. Beaver, p. 220.

[47] As above, p. 221.

[48] As above, pp. 172–73.

"The next movement is to cut off the limbs, such as are from 2 to 5 and 6 inches in diameter, and reduce them to a proper length to be moved to the water, and transported thence to the vicinity of their lodges; where they are sunk in a pile as their store of winter provisions. Upon this work, the whole family engage with the most persevering industry, and follow it up night after night, until the work is accomplished. The greatest number of Beavers ever seen thus engaged by any of my informants was 9, while the usual number is much less."

Similar testimony is given in Long's "Expedition to the Rocky Mountains."[49] "Three Beavers were seen cutting down a large cottonwood tree; when they had made considerable progress, one of them retired to a short distance, and took his station in the water, looking steadfastly at the top of the tree. As soon as he perceived the top begin to move towards its fall, he gave notice of the danger to his companions, who were still at work gnawing at its base, by slapping his tail upon the surface of the water; and they immediately ran from the tree out of harm's way."

As an adjunct of work, the Beavers sometimes raise a platform of mud or rubbish around a tree. This enables them to reach up to a thinner place, and thus fell the tree more easily.

Col. L. M. Brett, in charge of Yellowstone Park, writes me, May 12, 1911: "On a recent trip in the Park, one of our scouts found where Beaver had recently felled several good-sized saplings across one of our new trails at a point at least half a mile from water."

The Dam

The dam is the most famous, if not the most remarkable, of the Beaver's undertakings. It is a vast structure, of sticks, stones, roots, mud, and sod, laid across a running stream to back up the water, ensure the Beavers depth enough to protect them from their enemies all summer, and preclude all danger of its freezing to the bottom in winter.

Morgan describes[50] two kinds:—the open stick dam, faced with mud on the upstream side, and through the top of which the water trickles all along; and the solid-bank dam, which is of earth, and has an overflow at one place, where it is reinforced with sticks. I take it that the latter is simply a very old dam in which the sticks have rotted away from the main structure, and which the grass and growing stuff have solidified into a green bank.

---

[49] Exped., 1823, I, p. 464; this passage apparently by Thomas Say.

[50] Am. Beaver, pp. 84–85.

The process of building, as nearly as I can tell from having seen many dams in all stages of growth, is as follows:

The Beaver and his wife first decide on the stream they propose to make into a pond—and it is always a small one, sometimes a mere spring. Morgan says[61] that "there is no instance . . . where a dam has been constructed across a stream having a greater depth than two feet at the site of the structure, when the water is at its lowest level."

Next, they select a place where the bed is hard clay or gravel, neither rock nor bog being desirable; and then begin the dam by cutting and laying quantities of brushwood lengthwise in the deepest part of the stream bed, butts against the current. Each stick as it is laid, is partly covered near the thick end with mud, stones, or clay to hold it down; and the process is carried on until the wall is raised, and would, in section, be somewhat as shown in Plate LIX (p. 456). But very rarely is a log used, and never a stake.

By this time, the original bed of the stream is blocked; and the water flooding the shore, calls for a still wider dam. At both wings, it is spread.

Now we shall see why the curvature against the stream is usually given. The force of the current, especially at highwater, is such that a new formation, if down stream, is surely swept away; thus the only correct plan is forced on the Beaver. Exceptions occur, but there is generally an obvious explanation. Some log, root, stump, or hillock was there to suggest a different line, and offer assistance in making it safe.

Night by night, the Beaver family works on the dam, piling up sticks, and burying them in mud that is full of fibrous roots; or anchoring them down with stones of one to six pounds weight. The mud is got in the handiest way, the nearest place; that is, by diving to the bottom of the pond just above the dam. This has a tendency to enlarge the pond, so that in most cases, it is widest and deepest just above the dam, of which the reinforcement, the permanent strength, is in the flood-resisting brushwood.

Thus, it is seen that interlacing branches are the Beaver's safeguard against a washout, just as they are of human engineers who are forced to use wildwood material.

THE DAM-WISE BEAVER

The creature's cleverness in locating a leak, is illustrated in the following: The Hon. J. J. Hall, of Denver, says that some years ago, he made an irrigation dam on a stream near Teluride in San Juan Co., Colo. The dam did not hold; there was a leak somewhere in the bank. Several times he let the water out, and had expert engineers to seek for the leak. All efforts were in vain. Then two Beavers moved in. Immediately after they began operations, they must have found the leak—no doubt, by sensing the faint current—and they effectually plugged it. The dam was thus made tight, and has been good ever since.

---

[61] Am. Beaver, p. 105.

A similar instance is furnished by the Phillips, Me., correspondent of the Boston *Globe*. He says: "At Phillips upper village is a woolen mill, driven by water power, coming over a large dam in the Sandy River. Recently this dam has leaked freely; and, though repairs have been attempted, the task was found so complicated and difficult that the dam has never been put in proper shape by man since the leakage was first discovered.

"Suddenly, however, the leakage stopped; and an investigation showed that a colony of Beavers had taken up their abode in the mill pond, apparently coming from farther north on the Sandy River, where these creatures have been known in past years to be quite numerous."[52]

The labour of the Beaver knows no end—no dam is ever finished, or beyond need of repairs.

The Beavers near Yancey's, in Yellowstone Park, have, like most wild things there, realized the blessed peace of the Park. They came out soon after sundown while I watched them from a hide in 1897. I saw 4 swimming about at the same time. But only the biggest one seemed interested in repairing the dam; and he worked "like a Beaver" the whole time, never passing the dam without adding something. If nothing else was at hand, he would dive to the bottom for a gob of mud; and pound it into the dam wherever he fancied too much water was running over. It never seemed to occur to him that the water must go over somewhere. So the work of stopping the supposed leak goes on indefinitely and the dam grows bigger.

In menageries where they have given the Beaver the privilege of running water, there is much complaint that in their insensate mania for stopping the overflow, they block drains, etc.; oblivious of the fact that, but for benign and periodic human interference on their behalf, they would speedily bring on themselves the most disastrous kind of a flood.

Morgan remarks[53] that "dams begin to decay as soon as they are deserted by the Beavers, and quickly thereafter disappear"—which is surprising, considering their solidity. This is evidently true, however, for the eastern part of America abounds in beaver-meadows—that is, beaver-pond bottoms—yet it is very rarely indeed that one sees traces of the dams that made them.

---

[52] Forest & Stream, Jan. 16, 1909, p. 85.

[53] Am. Beaver, pp. 123–24.

DAM STUFF

Two of my observations in contradiction of popular belief, I was glad to have confirmed by Morgan:

1st. Among the scores of dams examined, I never saw anything of the nature of a stake; that is to say, the Beavers do not drive stakes. The nearest approach to it is seen in the following, by Edmund J. Sawyer:

"Only a few days since, I watched a Beaver repairing its dam. Cutting a willow near by, it swam to the dam, thrust the branch into the top of the work, then shoved at it vigorously from different angles until it held fast, resisting efforts to be farther moved."[54]

2d. Beavers rarely use logs in building a dam; I have seen them do it but once. Morgan also mentions a case;[55] it was 1 out of 63. Even that one he considered accidental; possibly that the tree fell on the dam, as it was a trunk that had been blown down, not felled by Beavers.

Stones are freely used when at hand, and Braithwaite says: "I have seen 4 of them [dams] that were entirely built of stones."[56]

A new dam is usually begun in summer; the work on it is pushed vigorously in late summer and early fall. It is probably untouched all winter.

According to Raymond Thompson, "When the spring freshets get in full blast, they often wash away the Beaver's dams; and the animals do not even attempt to repair them at that time. Practically no repair work is done in the spring."[57]

DAM DIMENSIONS

The best opportunity I ever had to study Beaver work was in the Yellowstone Park in 1897. On Lost Creek, not far from Yancey's, where I built a cabin and stayed some months, was a family of Beavers practicing their usual methods of making a great pond of a very little stream. It was from this colony that Elwood (Billy) Hofer took the 3 Beavers which were sent to the National Zoo; and, as nearly as we knew, there were 4 more left in the pond. After spending two days with compass and measuring rod, I produced the accompanying plans (Plates LV and LVI, at pp. 462-3 and 464)[58] of the Beaver's system of interior navigation. The source of all the water was a spring or springs in the marsh above. This took the form of a tiny rill about

---

[54] Nature Notes Yellowstone, April 29, 1925, p. 4.

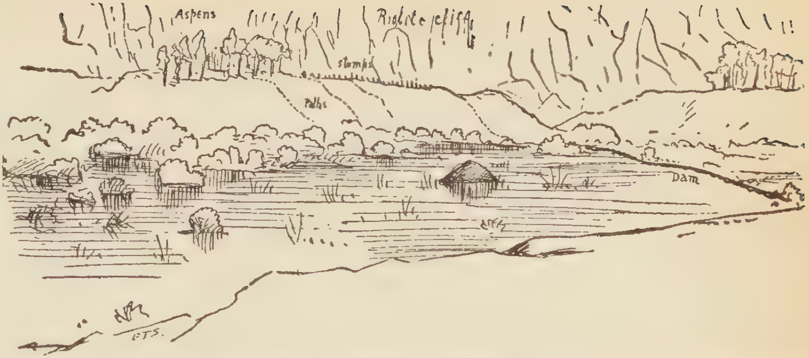
[55] Am. Beaver, p. 110.

[56] Habits, p. 1.

[57] Forest & Stream, Dec., 1925, p. 721.

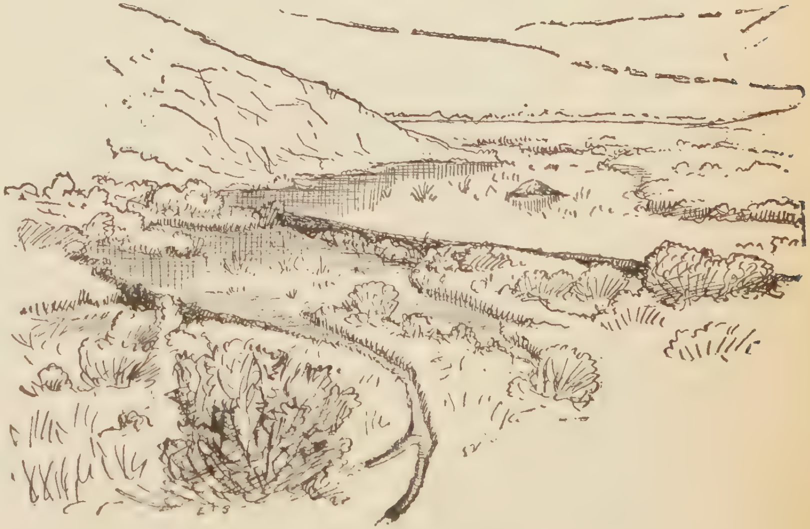
[58] These I published originally in Recreation Magazine, Oct., 1897, pp. 286–89.

Looking up the valley from the north



The main pond with house, and on the bank beyond, the remains of the aspen woods

First and second ponds from the east side. The present feeding grounds opposite



View from the aspen woods (present feeding grounds, 1897), the 70-foot canal in foreground

PLATE LVI.—VIEWS OF THE YANCEY BEAVER PONDS, YELLOWSTONE PARK, 1897

18 inches wide, and averaging 3 inches deep; and yet it was so managed by this industrious family as to result in 13 ponds.

The largest of these was 6 or 7 feet deep, 250 yards long, 80 yards wide, and covered about 3 acres. This was made by the great or central dam, which was doubtless the oldest; for the aspens opposite were evidently the first to be cut away, the willows in the pond it made were dead, the house was in this pond, and, finally, the fact of its superior size was some guarantee of its seniority. This dam was built largely of stones at the east end where it reached the talus of the cliff; and entirely of mud and sticks where it ran into the marsh. During the first night of my visit, the Beavers added a charred pole, 18 feet long and 5 inches thick—the only pole I saw used there. This dam was 301 feet long, 15 feet wide at base, $4\frac{1}{2}$ feet high in the deepest place, measured to the bed of the stream just below the face; it contained between 100 and 200 tons of material. Such a structure must have taken years of labour, and generations of Beavers to produce. Twenty-four yards below this was the second dam, most happily, if unwittingly, placed to relieve the pressure on the first.

Morgan describes[59] in detail dams which were 488 feet and 551 feet long.

The highest dam he had knowledge of was "about 35 feet long, 12 feet in vertical height; and with a slope of interlaced poles on its lower face, upward of 20 feet in length."[60]

The largest dam, that is, the one which he was "well assured . . . is not surpassed in magnitude by any other Beaver dam in North America"[61] is 260 feet 10 inches long, 6 feet 2 inches high, 18 feet wide at base; holding the water above it at 5 feet higher than in the pool below.[62] This dam must have contained about 250 tons of material.

The dam which makes Beaver Lake in Yellowstone Park, I believe is the longest ever recorded. I saw it from a distance, but had no opportunity of measuring it. General S. B. M. Young writes me that it is about 700 feet from end to end.

Landing Places

Reference to the plan (Plate LV, at pp. 462–3) shows a great many little docks or landing places. These are short canals with raised mud or sod wharfs at the end; they are either lookouts or sunning places. They are found chiefly on the western side, as there is no food on the eastern bank. Usually, from them there are paths leading farther afield.

---

[59] Am. Beaver, pp. 122, 129.

[60] As above, p. 119.

[61] As above, p. 99.

[62] As above, p. 97.

The dock seems to be the small beginning out of which grew what some consider the Beaver's most extraordinary achievement—the canal.

The Canals

Most naturalists who have studied them agree that the canal is, by far, the most wonderful of the Beaver's engineering feats—not only as interesting as the dam, but, according to Morgan,[63] even stronger evidence of intelligence. He says:

"In the excavation of artificial canals, as a means for transporting their wood by water to their lodges, we discover, as it seems to me, the highest act of intelligence and knowledge performed by Beavers. Remarkable as the dam may well be considered, from its structure and objects, it scarcely surpasses, if it may be said to equal, these waterways, here called canals, which are excavated through the lowlands bordering their ponds, for the purpose of reaching the hardwood, and of affording a channel for its transportation to their lodges. To conceive and execute such a design, presupposes a more complicated and extended process of reasoning than that required for the construction of a dam; and, although a much simpler work to perform, when the thought was fully developed, it was far less to have been expected from a mute animal."

Many canals in all stages of growth are shown on the plan (Plate LV, p. 463); but the largest and most interesting is the 70-footer, leading westward from the second pond. It is the highway to the feeding grounds; is about 18 inches deep up to the fork, beyond which it is but 12 inches deep. It is clean-cut with sharp, hard edges, and has a most artificial look. It ends abruptly at the foot of the bank; and then the path, sharply defined, continues on to the woods, 145 feet farther, and 30 feet higher up.

Morgan describes and illustrates three good examples of canals found near Marquette, Mich. These were 365 feet, 523 feet, and 579 feet long, respectively. All were 2 to 3 feet wide, and had throughout about 18 inches of water. All led from the residential pond to the feeding grounds. (Plate LVII, a, b, and c.)

(a) The first of these,[64] 365 feet long, reaches to the foot of a hill, and then forks as shown. These forks are the remarkable feature of this; "their construction along the base of the high ground gave them a frontage upon the canal of 215 feet of hardwood lands, thus affording to them along this extended line the great advantages of water transportation for their cuttings."

---

[63] Am. Beaver, p. 191.

[64] As above, pp. 197–98.

(b) The other two are remarkable, not only on account of their length, but because also of their locks. These are best illustrated in the 523-footer.[65] Each lock is a low dam making a foot rise in water level; over these, the logs are dragged. While the main canal is supplied with water from the pond, the locks are fed with rain water gathered by the 142-foot dam next the swamp.

(c) The 570-foot canal[66] has the same general plan as the other, with two locks; but it adds an important feature, namely, a wing-dam set at such an angle into the river that it deflects water enough to keep the canal well filled.

The longest canal I ever examined was a very old one at Gal Pond, near Wanakena, St. Lawrence Co., Adirondacks, N. Y., Aug. 4, 1908. It was 654 feet long, nearly 4 feet wide, and led from the pond to a grove of poplar and yellow birch. Although abandoned for fully 50 years, it was very well marked and showed many Beaver cuttings.

Some valuable observations on a much longer and larger canal are supplied by S. Stillman Berry. This he observed in Montana, and fully set forth.[67] The canal connected the Musselshell River with a remote feeding ground. It was in all 1,145 feet long.

"Measurements taken in the latter part of the month of August, 1918," he says, "showed that near the main bend . . . the canal had a low water diameter of 5 feet, or of 9 feet 6 inches measured across the summits of the levees at the same point. At the mouth, it was 9 feet in diameter (8 feet at water level), with a maximum depth of 1 foot 8 inches, and a low water depth of 10 inches. Where it cut through the willow bank . . . the canal diameter at high water level was 6 feet 9 inches; at low water level 5 feet 6 inches. The low water depth at this point was 1 foot to 1 foot 3 inches. The river near the mouth of the canal was about 50 feet wide at this time."[68]

In addition to the service of floating logs and sticks to camp, there is a second use for the canals pointed out by Morgan.[69] He found them cut across the neck of long points on the river, and even across long islands in the pond, "for the obvious purpose of saving distance in going around."

---

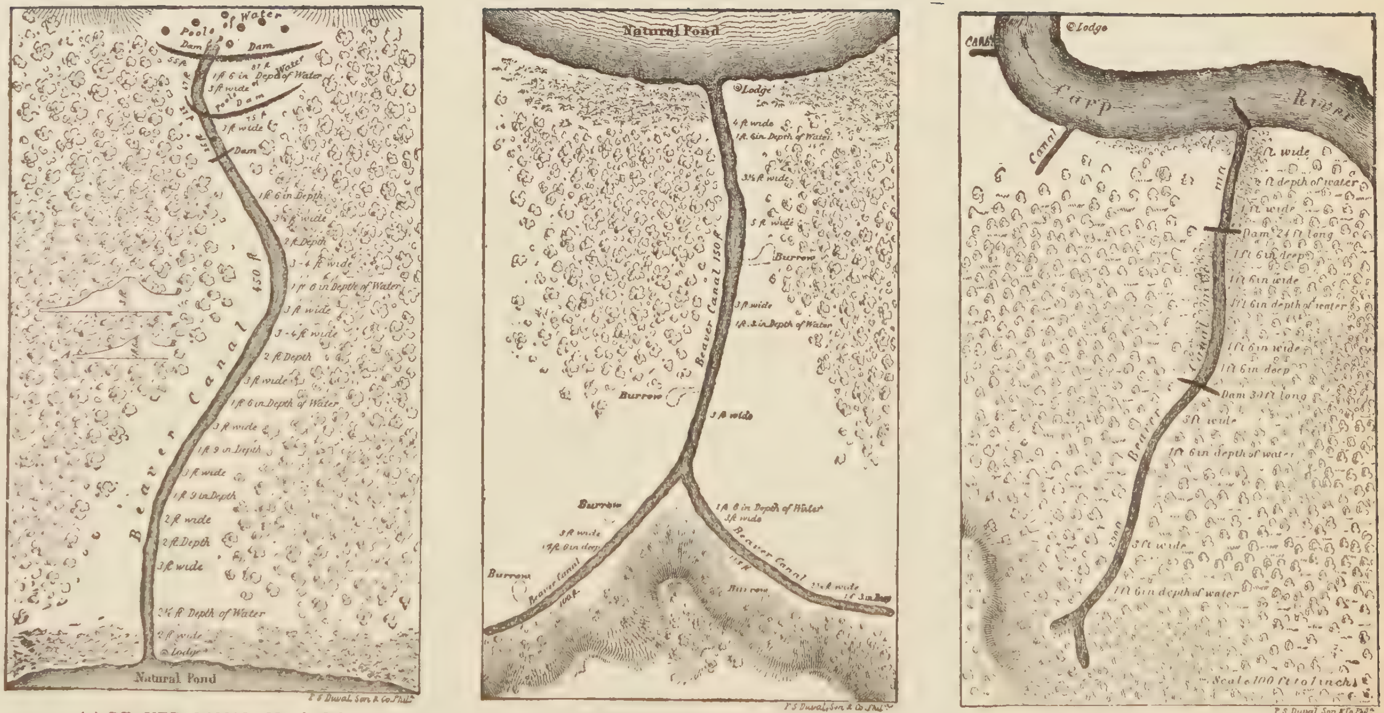
[65] Am. Beaver, p. 196.

[66] As above, p. 200.

[67] Journ. Mamm., May, 1923, pp. 92–103.

[68] As above, pp. 97–99.

[69] Am. Beaver, p. 202.



(*a*) BEAVER CANAL, North Side

(*b*) BEAVER CANAL, South Side

(*c*) BEAVER CANAL, CARP RIVER

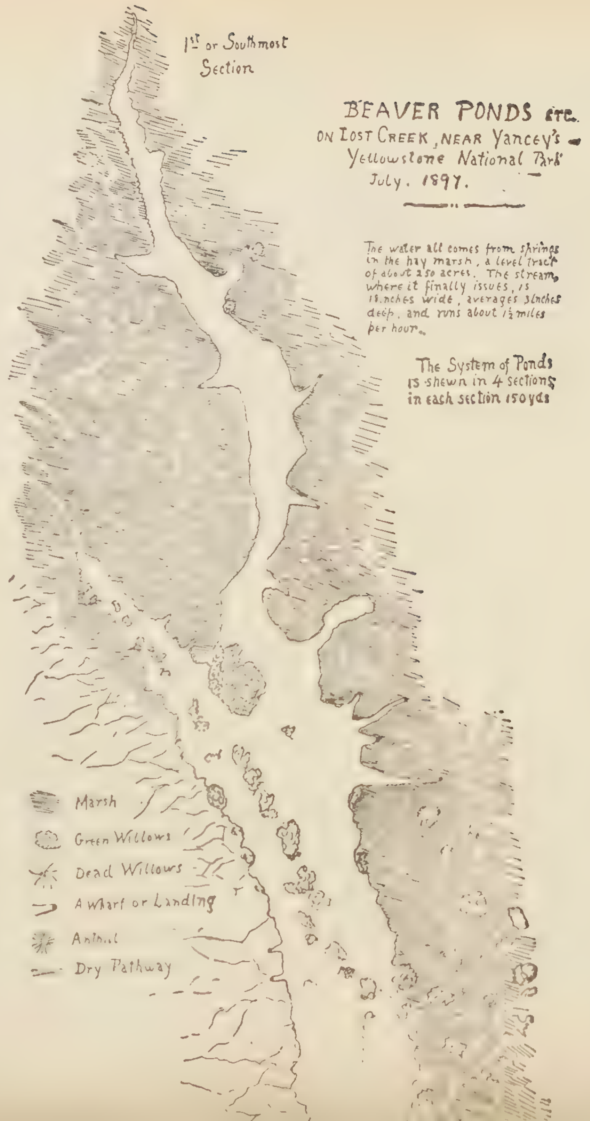
PLATE LVII.—THREE REMARKABLE BEAVER CANALS, REPRODUCED FROM MORGAN'S AMERICAN BEAVER

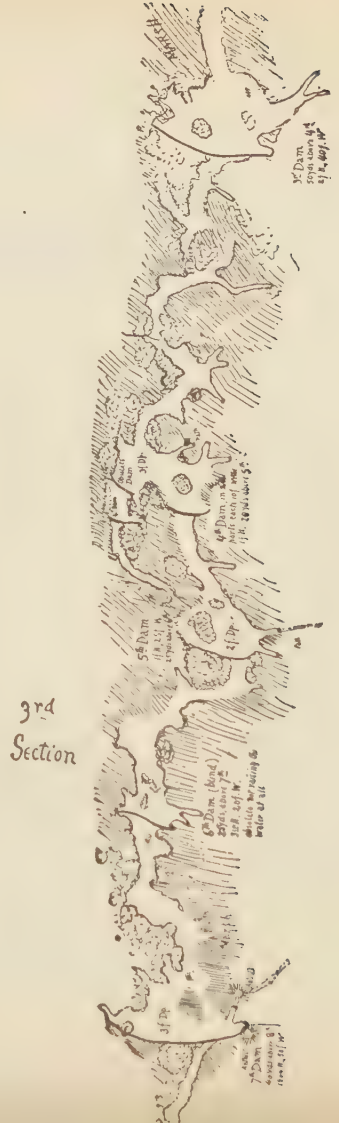
They are as follows: (*a*), 365 feet long; (*b*), 523 feet long; (*c*), 579 feet long

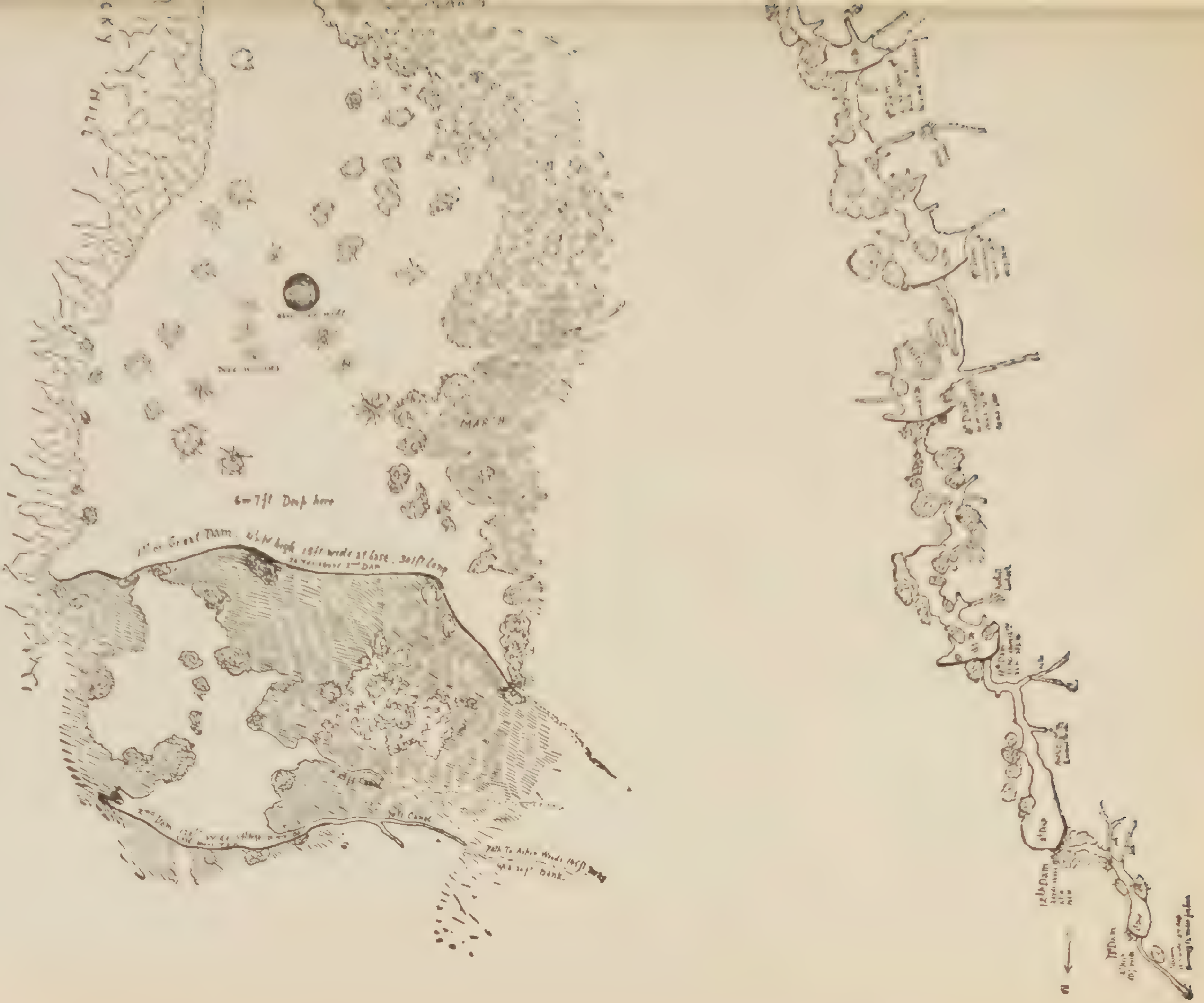
BEAVER PONDS etc.
ON LOST CREEK, NEAR YANCEY'S — Yellowstone National Park
July. 1897.

The water all comes from springs in the hay marsh, a level tract of about 250 acres. The stream, where it finally issues, is 18 inches wide, averages 3 inches deep, and runs about 1½ miles per hour.

The System of Ponds is shewn in 4 sections in each section 150 yds




3rd Section
Marsh
3rd Dam 50 yds above 4th 2 ft. H. 40 ft. W.
Double Dam
3 ft Dp.
4th Dam in 2 parts each 10 ft. W. 1½ ft. H. 20 yds above 5th
5th Dam 1½ ft. 25 ft. W. 25 yds above 6th
2 ft Dp.
6th Dam (blind) 25 yds above 7th 3 ft. H. 20 ft. W. obsolete but raising the water at all
Marsh
3 ft Dp
Animal
7th Dam 60 yds above 8th 1 ft. H. 50 ft. W.



CKY HILL
MARSH
6-7ft Deep here
1st or Great Dam. 4½ft high 18ft wide at base. 30ft long
2nd Dam
Canal
Path To Aspen Woods 165ft
4 to 10ft Bank
12th Dam
13th Dam
N

PLATE LV.—THE YANCEY BEAVER PONDS, YELLOWSTONE PARK

Drawn from survey made on the ground by Ernest Thompson Seton, July, 1897

In brief, then, these canals are among the most wonderful of all the Beaver's wonderful undertakings. They are plainly, the result of a plan adhered to from the beginning. They are made at a cost of enormous labour extending over years, and are kept in repair only by unremitting attention and toil.

They are unquestionably made for the convenience of reaching the feeding ground without a dangerous overland journey; and to assist in the transportation of the heavier sticks used when storing winter food. That is to say, the canals are made for precisely the same reason as those made by man--for the easy transport of passengers and freight.

Beaver Burrows

The Beaver burrow or den is an older institution, probably, than either the lodge or the dam. It is made in a bank near deep water, and is very simple in plan. It has a single entrance, which is below water line under some tree, root, or overhanging bank; it has a diameter of a foot or 18 inches, and a length of a dozen feet. In many cases, it is so enlarged by long use, that a man can crawl into it. It leads to a chamber just above the water line, under a root or stump or clump of bushes, which strengthens and guards the roof, that is here made thin enough to admit air, as we shall see.

A good typical example is shown (Plate LVIII, p. 479); this is the uppermost burrow seen on b, Plate LVII.

In streams which have always plenty of water, and which therefore need not, and indeed cannot, be dammed, the Beaver elaborates the bank-den or "wash." On the Yellowstone, Morgan saw a number of these in 1862, and writes: "The entrances or passageways often extend back 20 feet into the bank; and each communicates with one or more underground chambers, which are always found near the surface."[70] The individuals that live in these, are called "Bank Beavers." I saw numerous examples of their work on the Nyarling River, Mackenzie District, in June, 1907.

In many cases, their entrance is protected with a mass of sticks, which also is winter food. This pile is called a "false lodge." A higher development of the false lodge is seen when it is made by a lake. Then there is no annual freshet to carry away the pile, so it grows yearly.

Over the chamber in the bank, is a thin place made to admit air. In the course of time, this ventilator may give way, leaving the chamber dangerously exposed; in which case, the Beaver is seen, with true constructive ingenuity, repairing the ventilator with a pile of interlacing sticks.

---

[70] Am. Beaver, p. 159.

Then, as Morgan remarks:[71] "It is but a step from such a surface pile of sticks to a lodge with its chamber above ground, with the previous burrow as its entrance from the pond,"—a case which is precisely paralleled by the bank-house of the Muskrat.

At one time, it was supposed that the Beavers inhabiting a bank-burrow were of a different kind; or, as some said, were outcasts, who for some reason, had been driven from the great family lodge in deep water. There is but little to support this view. There are, indeed, outcast Beavers, and usually they dwell in a bank-burrow. On the other hand, all Beavers do so when nature has given them a sufficiency of deep water without the help of a dam.

It is usual for Beavers to have several burrows as well as a lodge. In the case of the Lost Creek Beavers, one side of this pond was rock; the other side level marsh. So they may have had no burrows; at least, I saw no signs of them.

The Beaver Lodge

The step from the burrow to the bank-lodge is easy. The roofing of sticks made to protect the ventilator, and the continual enlargement of the chamber below inevitably develop the burrow into the bank-lodge, examples of which are shown in Plate LVIII.

From the bank-lodge, the step is easy to the island lodge; and when the island is a mere upturned root or hummock, we reach the final and most specialized dwelling of the Beaver—the moated lodge in the pond.

The development of this may be in two different ways. In the first, the bank-lodge is gradually converted into an island lodge by the rising of the water behind the ever-growing dam, and the digging out of the mud on the land side, to improve at once the house, the dam, and the swimming.

There is, however, another approach to the lodge. Out in the shallow water, the Beavers select a bunch of willows, a log, a rock, or an upturned root, and pile mud and sticks on this, until it settled into a solid mass on the firm foundation with an ever-deepening moat around it; for the Beavers dive, and dig from the bottom, whenever they need mud for lodge or dam.

A typical lodge is a rounded mass of sticks, and occasionally stones. It is 20 feet across the base, and 3 to 5 feet above the water level; the walls are about 2 feet thick. The whole is cemented with mud.

The great pond in the Lost Creek Series at Yancey's, contained but one lodge; this was enormous. It looked 25 feet through, and as high as a man; but, having no boat, I could make no measurements.

---

[71] Am. Beaver, p. 165.

Braithwaite says that the finished and frozen lodge is strong enough to support the weight of a full-grown Moose, without collapsing.[72] Yet Enos A. Mills testifies that "one night, two of the dead spruces were hurled into the [Beaver] pond. The smaller one had fallen across a housetop; but the house was thick-walled, and, being frozen, had sustained the shock which broke the spruce into sections. The other fallen tree fell so heavily upon two of the houses that they were crushed like shells. At least 4 Beavers were killed, and a number injured."[73]

His Home Layout

As a rule, the lodge contains but one circular chamber, which is about 2 feet high, and 6 feet across. When two or more chambers are found side by side, there is no connection between them. They are, indeed, separate lodges accidentally touching.

A remarkable multiplex lodge is thus described by Hearne: "I have seen a large Beaver house built in a small island, that had near a dozen apartments under one roof: and, two or three of these only excepted, none of them had any communication with each other but by water. As there were Beaver enough to inhabit each apartment, it is more than probable that each family knew its own, and always entered at their own door, without having any farther connection with their neighbours than a friendly intercourse."[74]

There are usually two entrances to each lodge; rarely more—sometimes but one. The first, abrupt, often winding, is the ordinary runway; and the other, quite straight, is for bringing in wood. They are 1½ to 2 feet wide, and 5 to 10 feet long. They are 2 or 3 feet below water level on the outside; but inside, open well above water line. The walls of chamber and passages are finished with mud, which is plastered smooth, as in an adobe house. The floor, about 4 inches above high tide, is covered with a solidified mass of mud and small twigs.

The only air is what comes through the walls, or is incidentally brought in the fur of the inhabitants, or functionally in their lungs. There is more or less dry grass or wood shavings for bedding.

"Each Beaver," says Braithwaite, "has his bed neatly placed against the inner surface of the wall. His bedding is composed, usually, of wood fibres stripped fine, about like an Indian's broom. In the case of lake Beaver, with whom wood is apt to be scarce, blue joint grass is used for bedding. This bedding is taken out pretty often, and a fresh supply brought in; for the Beaver is a most cleanly animal, and his couch is soon fouled by his muddy occupation."[75]

---

[72] Habits, p. 2.

[73] Watched, p. 51.

[74] Journey, p. 230.

The lodges "are perfectly air-tight, and being steam-heated by the Beavers, must be very warm and cozy in the coldest weather. Very old Beavers usually build larger houses, work more systematically, and go in for comfort generally."[76]

To this, the same veteran naturalist adds: "They will usually build a new house every year."[77]

Powers, Speed, etc.

We have already discussed the tree-cutting gift of this animal. His other powers show him specialized for the water rather than for the land. When high and dry afoot, he is so slow that man, as well as any of his natural foes, can easily overtake him. He is not generally credited with power to leap; yet the Hon. J. J. Hall, of Denver, writes me that his "friend, Richards, whose camp is 25 miles west of Cody, was riding one moonlight night in the autumn of 1922, by a Beaver stream in the region. He saw a Beaver hard at work. He watched it for some minutes, then deliberately alarmed it. It made the most surprising leap he had ever seen made by a Beaver, and reached the water. The distance cleared by the Beaver was 10 feet on the level."

When cornered, or cut off by the water, he does not, by any means, surrender. Braithwaite tells the fate of his friend's Dog in the woods. He says: "Turnbull had a thoroughbred mongrel Dog which was jealous of the Beaver, and one day attacked him. He only did that once, for the Beaver nipped the Dog's tail off quicker'n a Cat could catch a Mouse."[78]

On the land, the Beaver is but a poor traveller. In the water, he is not one of the swift swimmers; he seems to me to go no faster than a Dog—two miles an hour, is, I should think, his fast speed.

In swimming, the Beaver relies on his hind feet as paddles; the tail is used chiefly as a rudder or for diving; the fore feet are little employed.

Diving for Distance

But his diving power is remarkable.

On Yellowstone Lake, Aug. 5, 1897, I saw a Beaver a good quarter mile from shore; he dived and was seen no more. The water was like a mirror, so we should have seen him had he reappeared short of the land.

---

[75] Habits, p. 2.

[76] As above.

[77] As above.

[78] As above, p. 3.

The trappers generally credit the Beaver with power to swim a quarter of a mile without coming up to breathe, which implies that he can go fully 5 minutes without breathing.

On this subject, Dr. Charles E. Johnson writes: "A specimen which I once took in a trap, dove; and after it had been under probably half a minute, I took out my watch to time it. At the end of 5 minutes and 10 seconds, I began to fear that the Beaver had escaped; and, poking around with a stick to see if it was still there, after a few seconds located the Beaver under the bank; when I poked it, it came to the surface. It had been under water altogether about 6 minutes; and no doubt, would have remained under longer, had I not disturbed it."[79]

Braithwaite's observations imply that the underwater stay can be greatly prolonged, almost made indefinite, by means of an expedient, a sort of artificial respiration that the species has evolved. He says: "The ability of a Beaver to remain under water for a long time, is really not so tough a problem as it looks. When the lake or pond is frozen over, a Beaver will come to the under surface of the ice, and expel his breath so that it will form a wide, flat bubble. The air, coming in contact with the ice and water, is purified, and the Beaver breathes it in again. This operation he can repeat several times."[80]

MATING AND BREEDING

Most authorities maintain the Beaver to be a strict monogamist; notwithstanding that Vernon Bailey holds the species to be polygamous.[81] The mating season is January or early February; and the pair make, then and there, a contract for life.

Gestation lasts about three months. A valuable contribution on the gestation of the Beaver in Oregon, is offered by Theo. H. Scheffer, of the Biological Survey, Puyallup, Wash.[82] In each of 3 pregnant females, he found 4 fetuses; in 3 others, there were 3. Apparently, impregnation took place in late January.

On Feb. 8, fetal sacks were about 1¼ in. in diameter
Mar. 8, 8 in. in total length
Mar. 26, 5¼ " " " "
Apr. 7, 8¾ " " " "
Apr. 10, 10½ " " " " and furred all over
Apr. 17, 8¼ " " " " " " " "

---

[79] Adir. Beaver, p. 175.

[80] Habits, p. 3.

[81] Beaver Farming, p. 9.

[82] Journ. Mamm., May, 1925, p. 129.

Toward the end of April, the mother separates herself from her mate; that is, I suppose, compels him to move out and keep away, while she prepares for the brood in the old lodge. She makes a warm nest of dry grass—so at least say the trappers—but it is not very clear how the mother keeps the grass dry when she must swim under water with it. Harry V. Radford believes that the bedding is not grass, but always of wood finely shredded in the lodge, therefore dry.

THE KITS

Here the kits, as the trappers call them, are born in the month of May; their eyes are open from birth.

Usually, they number 2 to 5. According to Morgan,[83] however, one William Bass "found 8 young Beavers in a foetal state in one female, and 8 young Beavers born also in a single lodge. He had also found 6 young ones a number of times; and all the numbers below this, down to a single young Beaver." Since the mother has but 4 teats, a family of 8 must be an embarrassing problem.

Vernon Bailey says: "Nine Beaver, 5 young and 4 old, is the largest number I have ever found inhabiting one house; but others have reported larger families in very large houses."[84]

Hearne says that the Beaver families "seldom exceed 4 old and 6 or 8 young ones; though, by chance, I have seen above double that number."[85]

Speaking of an exceptionally large lodge with many chambers, the same traveller says: "The Indians of my party killed 12 old Beaver and 25 young and half-grown ones out of the house . . . and on examination, found that several had escaped."[86]

At the age of a month, the young begin to eat solid food, and go abroad with the mother.

Vernon Bailey's experiences with two baby Beaver in Minnesota,[87] offer valuable light on the raising of such delicate creatures. He and his Indian guide went to a Beaver lodge, knocked civilly on the outer wall, and then watched, as he says, "for a responsive line of bubbles sent up from the fur of the old Beaver as she swam away below the surface.

"'There's one—two of them,' suddenly exclaimed Chippewa John, pointing to a couple of small brown heads on the water a short distance from the house. . . .

---

[83] Am. Beaver, p. 221.

[84] Journ. Mamm., Feb., 1926, p. 42.

[85] Journey, p. 228.

[86] As above, p. 230.

[87] Johnny & Paddy, pp. 3–7.

"Evidently the babies had been enjoying their luncheon inside when the mother became alarmed at our disturbance, and plunged out of the house, the babies clinging each to a tough nipple until well out in the lake—a safety device common to many young rodents. . . .

"'Get them quick, or they'll drown,' we cried, for it was evidently their first swim. Shooting the boat ahead, our guide reached down and picked up by the tail, first one and then another furry, dripping, little body. Our first Beavers! Now we could really learn something."

But more than once, the attempt to raise them came near a tragic end, for the usual reason—unnatural food, no Beaver milk.

"Alas, the formula of Beaver's milk was an unknown quantity," says Bailey, "and on a cow's milk diet, the poor little fellows became the prey of all the ills to which other motherless babes fall heir. We experimented with skimmed, boiled, and diluted solutions, adding popple leaves to give it a more natural flavour. Later, we tried rolled oats and bread. Nevertheless, the digestive tracts of the little Beavers never fully recovered tone until they graduated to their natural wild food. Lily pads and stems seemed to be particularly good medicine, with water grass and the white stalks of tulés and cat-tails by way of variety. After about 6 weeks, when they gave up milk entirely, they ate the bark, twigs, and leaves of a variety of bushes. Aspen was their favourite tit-bit, but beaked hazel, pin cherry, bush maple, alder, willow, and birch were also devoured with gusto."

In summary, then, his experiences in raising them were too emotional at times. The kits were eager enough to feed, but the natural food was not available, and the best solution unknown. If some of our milk experts would tell us the exact composition of Beaver milk, Wild Sheep milk, Antelope milk, etc., they could help us to solve the hardest of all the problems in raising wild animal babies.

Enos Mills, describing a wild family that he was observing, says: "A few mornings later, the baby Beavers appeared. The mother attracted my attention with some make-believe repairs on the farther end of the dam; and the 5 youngsters emerged from the house through the water, and squatted on the side of the house before I saw them. For a minute, all sat motionless. By and by, one climbed out on a projecting stick and tumbled into the water. The others showed no surprise at this accident.

"The one in the water did not mind, but swam outward where he was caught in the current that started to carry him over the dam. At this stage, his mother appeared. She simply rose beneath him. He accepted the opportunity, and squatted upon her back with that expressionless face which Beavers carry most of the time. . . . The youngster sat on his mother's back, as though asleep; while she swam with him to the house. Here he climbed off in a matter-of-fact way, as though a ride on a ferry-boat was nothing new to him."[88]

At six weeks, they are weaned; but they continue with their mother for a year longer at least.

"The mother Beavers," says Braithwaite, "remain at home all summer, while the rest of the tribe are ranging about until September, when they commence to club together again. The kittens generally remain with the mother for two years. When they are three years old, they mate and start off on their own hook."[89]

The Father

What little evidence there is, goes to show that the male is a model parent. Naturally, his duties are small, since he is not called on to nurse, feed, lead, or defend the young. Some fathers are considered models when they refrain from doing bodily harm to their offspring; and are especially admired if they keep away altogether while the young are helpless in the nest.

He and his pals go a-roaming all summer, sometimes living in lone bank-houses, sometimes gathering at the club, which is a lodge of males only.

In September, he rejoins the family circle, makes the acquaintance of his offspring, and sets vigorously about preparing house, dam, and larder for the winter coming on.

My observations would indicate that, in these laudable activities, he is by far the hardest and most assiduous worker. His industry is tireless. Both wife and children take it for granted that father will do it; so they have a comparatively easy time.

Outcast or Bachelor

Just as, among Buffalo and Moose, we have the lone bull that is more or less of an outcast, so in the Beaver world, we have individuals—old males—that are outcasts or degenerates, either from choice or necessity. Many strange theories are brought forth by trappers and Indians to explain these. This much only is certain—they are outcasts, and they are failures.

"It is a curious fact," says Prevost, the trapper,[90] "that among the Beavers, there are some that are lazy, and will not work at all, either to assist in building lodges or dams, or to cut down wood for their winter stock. The industrious ones beat these idle fellows, and drive them away, sometimes cutting off part of their tail, and otherwise injuring them. These 'Paresseux' [idlers] are more easily caught in traps than the others, and the trapper rarely misses one of them. They only dig a hole from the water running obliquely toward the surface of the ground 25 or 30 feet, from which they emerge, when hungry, to obtain food; returning to the same hole with the wood they procure, to eat the bark.

---

[88] Watched, pp. 52–53.

[89] Habits, p. 2.

[90] Quoted in Q. N. A., I, p. 352.

"They never form dams, and are sometimes to the number of 5 or 7 together; all are males. It is not at all improbable that these unfortunate fellows have, as is the case with the males of many species of animals, been engaged in fighting with others of their sex; and, after having been conquered and driven away from the lodge, have become idlers from a kind of necessity. The working Beavers, on the contrary, associate—males, females, and young together."

Morgan offers an explanation which at least puts the "sluggards" on a higher plane. These "outcasts," he says, "are probably such Beavers as, having lost their mates, refused afterward to pair, and led thenceforth solitary lives in burrows."[91]

It has even been suggested that they are eunuchs, so made through accident or disease.

Describing the old outcast in the Beaver colony at Washington Zoo, Dugmore says: "It is difficult to imagine a more pathetic sight than that of the poor old Beaver, solitary and so entirely alone; within sight of his comrades, yet not among them; unable to join in their games and their work, living his lonely life like a hermit."[92]

"When spring came, it was found that the Beavers had increased in numbers, very much to the delight of all concerned: but the following year, when they were all full-grown, the rules and regulations of Beaverdom were put in force. They decided that there was one too many; and, according to their laws, he must either betake himself to some other locality, or submit to an untimely death. Now, the victim chosen—whether by ballot or by what other means, who can say—was our old friend; and, as it was impossible for him to leave the colony of his own accord, death would have been his lot, had not the keeper come to the rescue."[93]

Near Kippewa, Que., however, I knew of a solitary he-Beaver that did build a large dam in 1904. But, as noted elsewhere, he was not solitary from choice, and spared no effort till he had changed his condition, finally achieving a family of his own.

---

[91] Am. Beaver, pp. 136–37.

[92] Romance, p. 162.

[93] As above, pp. 167–68.

THE SOCIABLE WORKERS—SIGNALS

Being essentially sociable, the Beaver has many methods of communicating ideas. The first of these is the vocal. Young Beavers wail like crying children. Older ones hiss in menace, or utter a querulous "churr." When two meet in the pond, I have several times seen them nibble each other's cheeks, at the same time uttering a chattering noise; I suppose it is a friendly salutation.

"In the season of love," says Richardson, "their call resembles a groan, that of the male being the hoarsest; but the voice of the young is exactly like the cry of a child."[94] Whether this is a true love-song, is not yet determined. Perhaps, like many of their kinsfolk, they have some quite different rarely uttered, and joyful call—a prolonged expression, that has hitherto escaped observation.

The Beaver's most important signal—the one most often heard—is the "splash." While watching the Beavers at Yancey's, I learned that, at once, on discovering danger, each Beaver gives a great slap with his tail and dives; this is understood by all, and repeated by each as he plunges. Among the hunters on the Nyarling River, I found that it is considered the sign of a mortal wound if the Beaver dives without slapping.

The sound of it on a quiet evening is very far-reaching; it is, in fact, two sounds—one a loud "slap" as of a paddle, followed at once by a deep, hollow plunge, as though a ten-ton boulder had been dropped in the water.

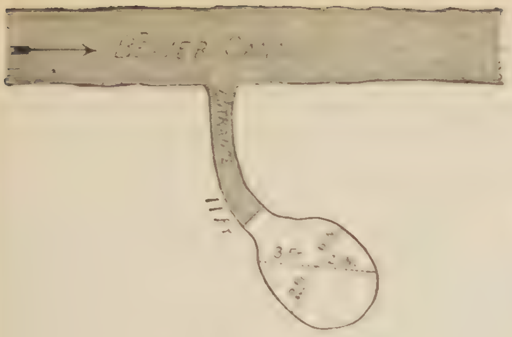
That there are many other signals in use among them, is beyond question.

Apparently, Mills is convinced that, in the wet republic, there is an elaborate system of intercommunication; and yet he cannot divine its form or elements. He says:

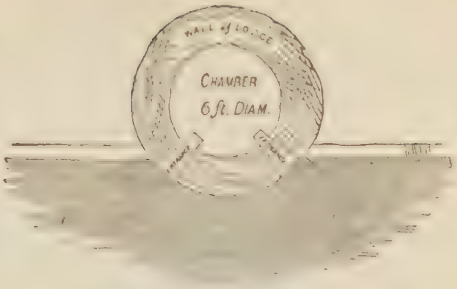
"Beavers coöperate and carry out a distinct plan; in doing this, they work both unitedly and singly. The whole work, however, advances as though to a plan, and as though under constant supervision. Through the years, I have seen Beavers working hundreds of times. Their work is nearly always sufficient, and apparently under the direction of an expert in Beaver work; but never have I seen any sign or signal given by a Beaver that I could positively say was an order or command. But I see no way of explain-

---

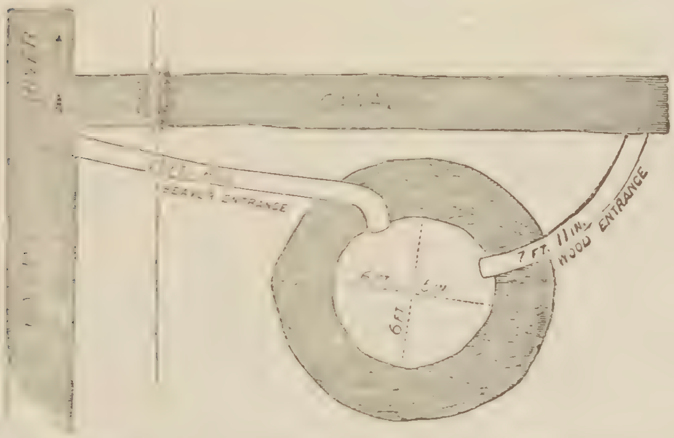
[94] Narrative, p. 91.



Plan of a Beaver burrow
(From Morgan)



Ground-plan of a bank-lodge
(From Morgan)



Ground-plan of a more elaborate bank-lodge, showing the nearly straight wood entrance in dead water, and the Beaver entrance in the running stream
(From Morgan)

A 5-inch aspen just felled

PLATE LVIII.—BEAVER WORKS

ing the magnitude of Beaver works, and the skill shown therein, except through coöperation under an acknowledged leader."[95]

Curiosity and Tolling

Henry Bannon attributes a large measure of curiosity to the species. He says: "A strange noise, such as is made by striking the canoe with the paddle, or by casting a stone into the water, will often call Beaver from their lodge in the daytime. Once the trapper tapped his gun-stock three or four times with a knife. In less than a minute, a Beaver emerged from his lodge, and swam about until he saw us; then he returned into the lodge."[96]

"Upon another occasion, we were near a lodge located in a pond whose waters were not clear. Again the same noise was made. After waiting several minutes, and neither Beaver nor ripple appearing on the surface, we turned to go. As we did so, there was a splash a few feet in our rear. The Beaver had come through a little underground canal to a small pool near where we stood, and had evidently been watching us all the time."[97]

What is it that attracts the Beaver? Curiosity concerning a stranger, or accidental use by a stranger of a definitely established signal? That there is an important, unwritten chapter here awaiting the wise watcher, is evidenced, among other things, by Millais's note on Beaver tolling. He says:

"Beavers, when they have been undisturbed for long, are very curious in relation to strange sounds. They will come swimming out of their house even at the firing of a gun. The Indians usually call them with a hissing noise, or one produced by munching the lips. Another favourite 'toll' is a sound made by tapping the trousers with the hand. The most successful Beaver 'caller' in Newfoundland is John Bernard—or Johnny 'Bow-an'-arrow,' as he is named by the Glenwood folk—who, when the season for the animals was 'open,' killed great numbers by making a sound that resembled the cutting of chips off a tree. It is said that the unfortunate rodents never fail to respond to this noise."[98]

Mud Pies

Besides these signals, there is another way in which Beavers convey ideas. It may be called the mud-pie telephone. The Beaver, like birds, has a cloaca or one orifice urinal, genital, and anal combined; each (male or female) has, close to this, two pairs of glands. The large ones are the "barkstones" or castoreum glands, secreting castor, corresponding, according to Dr. W. W. Ely,[99] to the preputial glands; and the smaller, the "oil-stone," secreting a lubricant.

---

[95] Watched, p. 135.

[96] Days, pp. 513–14.

[97] As above, p. 514.

[98] Newfoundland and Its Untrodden Ways, 1907, p. 211.

The castor is a yellowish substance, commonly described as "strong-smelling." Its odour certainly is peculiar, but it seems to me rather faint. These two secretions are given off at will by the animal, usually while voiding urine or excrement; and are a most important, though ill-comprehended, method of intercommunication.

Whatever the explanation, there can be no doubt that the smell of castoreum has a wonderful fascination for the Beaver; and is used almost universally by the trappers, as a lure or charm to decoy the fur-bearer to his fate.

Nor is this infatuation confined to Beavers, for most mammals respond to its dangerous attractions; and mixed with various other substances to intensify it, or make it more easy to handle, it forms a part of every trapper's stock-in-trade.

This, probably, is the broad, underlying idea: the product of the gland varies with the age, sex, and condition of the individual. The next Beaver that passes, can get light on these things by study of the castor left in the little pile of mud; thus, it serves as a means of spreading intelligence; in particular, about sexual matters, hence its power.

When I was camped at Big Dam Lake, 40 miles east of Kippewa, Que., Sept. 21, 1905, I saw much Beaver work; and learned from Mittigwab, the Indian guide, that all of this was the work of one old male Beaver that had lived here alone for two or three years. He wandered as much as 15 miles upstream from the lake, and 1½ miles from water, especially in early spring, when the ice first broke up. He advertised energetically; for his mud pies, with a dash of informational castor, were on every corner and point for at least 100 miles of shore, proclaiming to all who understood what a very solitary and miserable life was his, and how earnestly he did strive and pray to find a mate.

But, for years, he continued alone. Beaver were scarce in that country; and trappers relentless when a strange Beaver wandered in. In 1906, however, his persistence was rewarded with success. A perfectly compliant and agreeable female responded to his ad. The credentials exchanged were evidently satisfactory; for in 1908, I learned that he was the happy patriarch of a large and successful community.

---

[99] Am. Beaver, p. 301.

PLAY

We should expect such a sociable creature to show considerable advancement in development of play; and even here, it seems the castor takes a prominent place. Morgan says:[100] "Occasionally, they indulge themselves at play, for which a formal preparation is made. After selecting a suitable place upon dry ground near the pond or stream, they void their castoreum here and there upon the grass; and, in the musky atmosphere thus created, spend some hours at play or basking in the sun. The trappers call these playgrounds 'Musk Bogs.'

"Two or three of them are often seen at play in the water—diving, swimming around, and ducking each other."

A trapper, named Prevost, called the attention of Audubon and Bachman[101] to a peculiar habit or game of the Beaver. "He said that when two Beaver lodges are in the vicinity of each other, the animals proceed from one of them at night to a certain spot, deposit their castoreum, and then return to their lodge. The Beavers in the other lodge, scenting this, repair to the same spot, cover it over with earth, and then make a similar deposit on the top. This operation is repeated by each party alternately, until quite a mound is raised, sometimes to the height of four or five feet."

Thus, they have invented a game on the line of piling dominoes, or playing "hands" as enjoyed by children; or possibly like a contest of social events between two social queens, each seeking to go the other one better, to set a higher mark.

"They are very playful," says Dr. John Richardson, "as the following anecdote will shew: One day, a gentleman, long resident in this country, espied 5 young Beavers sporting in the water, leaping upon the trunk of a tree, pushing one another off, and playing a thousand interesting tricks. He approached softly, under cover of the bushes, and prepared to fire on the unsuspecting creatures; but a nearer approach discovered to him such a similitude betwixt their gestures and the infantile caresses of his own children, that he threw aside his gun. This gentleman's feelings are to be envied: but few traders in fur would have acted so feelingly."[102]

E. L. Chicanot, telling of Beavers that he recently watched by night in central Alberta, says: "It was very interesting to observe them, though I was never able to determine exactly what they were doing—playing or making love; certainly they were not engaged upon any of the serious businesses of life. They circled about each other in a clumsily dexterous manner, and administered good-natured cuffs with their webbed paws. They snarled at each other much in the manner of playful puppies, though their naturally unprepossessing aspect detracted from a very happy mien. They never reëntered the water, but moved around on the same narrow spot; and when their antics grew monotonous, and there seemed no climax of any kind arriving, I backed carefully away, and am sure the animals never knew how near they had been to one of the humankind, or how imminent destruction might have been."[103]

---

[100] Am. Beaver, p. 223.

[101] Q. N. A., I, p. 353.

[102] Narrative, pp. 91–92.

FOOD OF THE BARK-EATER

Closely connected with the building instinct is the food instinct of this animal. His favourite diet in Canada is the bark of the poplar or quaking aspen; but he also eats the young bark and twigs of most of the hardwoods. In summer, he adds many kinds of vegetation, even berries, pond-lily roots, and marsh grass; and in winter, the wood itself.

But he never is known to eat any part of coniferous trees, except in the absence of other food; although he cuts them down for building material.[104]

Richardson thus sums it up: "Their favourite food is the bark of the aspen, birch, and willow; they also eat the alder, but seldom touch any of the pine tribe, unless from necessity; they are fond of the large roots of the *Nuphar luteum*, and grow fat upon it; but it gives their flesh a strong rancid taste.[105]

Enos A. Mills, with abundant opportunity, enlarges on this. Describing a certain Beaver family, he says: "The upper part of the area flooded by their pond had been a semi-swampy tract, bearing thick growths of water-loving plants. The roots of sedge, bulbs of lilies, tubers of many plants, and long, juicy roots of willow and alder, were made use of by these Beavers, facing a food shortage.

"I supposed it was only a question of time before they would be shut off by the thick ice from this root supply. But they dug a deep waterway — a canal about 2 feet wide, and nearly as deep — from the house in the centre of the pond to the heart of the rooty area. Even after most of the pond was frozen to the bottom, they had an open line of communication with the root supplies."[106]

"I had glimpses of the Beavers' eager digging through the clear spots in the ice. They tore the root-filled section to pieces, and devoured all that it contained. But not until the following summer, when the broken dam released the water, did I realize how deeply and completely the bottom of the pond had been stirred and ploughed. I have seen gardens uprooted by Hogs, and mountain meadows dug to pieces by Grizzly-bears; but neither of them equalled this."[107]

---

[103] Canadian Forest & Outdoors, Sept., 1923, p. 591.

[104] Am. Beaver, pp. 183–84.

[105] Narrative, p. 91.

[106] Watched, pp. 210–11.

Finally, he adds: "Beavers do not eat meat or fish, but chiefly bark, with a little of roots, mushrooms, lily bulbs, and berries."[108]

A suggestive inquiry is at hand from Frank A. Kaban, of Seattle, Wash. He writes me: "On one of their feed haul-ups, I found two *Cicuta* (or poison hemlock) roots, the tops and all the small rootlets of which had been eaten off. Each of the roots proper had two or three small bites taken out of them, as if they had been sampled.

"Could you tell me whether or not Beaver would be poisoned by *Cicuta ?* It is very common here; and if it is as poisonous as is commonly supposed, I don't see how any Beavers survive. I have never found a dead one."

In summary, Hearne says of his pet Beavers: "In general, during the winter, they lived on the same food as the women did, and were remarkably fond of rice and plum pudding: they would eat partridges and fresh venison very freely; but I never tried them with fish, though I have heard they will at times prey on them. In fact, there are few of the granivorous animals that may not be brought to be carnivorous."[109] Which last remark is true, in the same sense as the statement that small boys eat slate pencils and chalk.

STORAGE

Like most of the rodents which do not hibernate, the Beavers store up food for winter. All through the autumn, they labour. The suitable trees next the bank are first attacked; if they fall into the water, they are allowed to lie there, as it is easy to cut their branches later under the ice. If they fall on the land, all the branches are cut off into pieces of a size possible to handle, that is to say, "when 5 inches in diameter, they are usually about a foot long, when 4 inches in diameter, they are about a foot and a half long, and when 3 inches in diameter, are about 2 feet long. Poles from 1 to 2 inches in diameter, are often found 8, 10, or 12 feet in length; and also cut up into short lengths, from a few feet to a few inches long."[110]

---

[107] Watched, p. 212.

[108] As above, p. 134.

[109] Journey, p. 244.

[110] Am. Beaver, pp. 178–79.

These sticks are brought to the lodge to be stored in two different ways. The heavier timbers are sunk in the bottom of the pond. How they are sunk, is often discussed. I have heard men who should have known better, say that the Beaver sucks all the air out of them to make them sink; or that the Beavers charm them, but that your touch breaks the charm, and the logs float up. The fact is that most green woods are nearly as heavy as water; if waterlogged, they are heavier. The Beaver carries the green stick down to the bottom, and partly buries it in the mud; very little holds it. In a week or so, it is waterlogged, and lies there even if uncovered. If anyone pulls at a piece of poplar, for example, just after it is sunken, it floats and will not stay down without weighting. These things I saw and proved to my own satisfaction on the Nyarling River, near Great Slave Lake, in June, 1907.

The smaller branches are stored in a different way. In the water above Beaver lodges, that are situated in a current, is a pile of brushwood moored to the bottom, and apparently not used for food. This, Morgan considers, is a safe storage place for the smaller twigs that might be carried away by the stream."[111]

Bannon's opinion, after years of observations, is thus set forth: "During the fall, Beaver are busy animals. They are at work laying up their winter's cache of food. They come to the bank of the pond or the stream, climb up the trails, cut willow or cottonwood sticks, carry them to the water, and then swim with them to the cache near the lodge. The cache is in the water. To make it, the Beaver first plant a few sticks in the mud for the purpose of forming an obstruction. This done, they bring hundreds of branches and twigs, and so release them that they will catch against those in the mud, and become interwoven. The ice finally covers the water, but the Beaver's food is beneath the ice.

"During the winter, a Beaver goes from the lodge to the storehouse, cuts a branch from the cache, returns to the lodge, eats the bark, and then puts the peeled stick into the current which carries it away."[112]

During the summer, the Beaver commonly takes the piece into the lodge, eats the bark off, and later adds the useless stick to the roof-tree or to the dam.

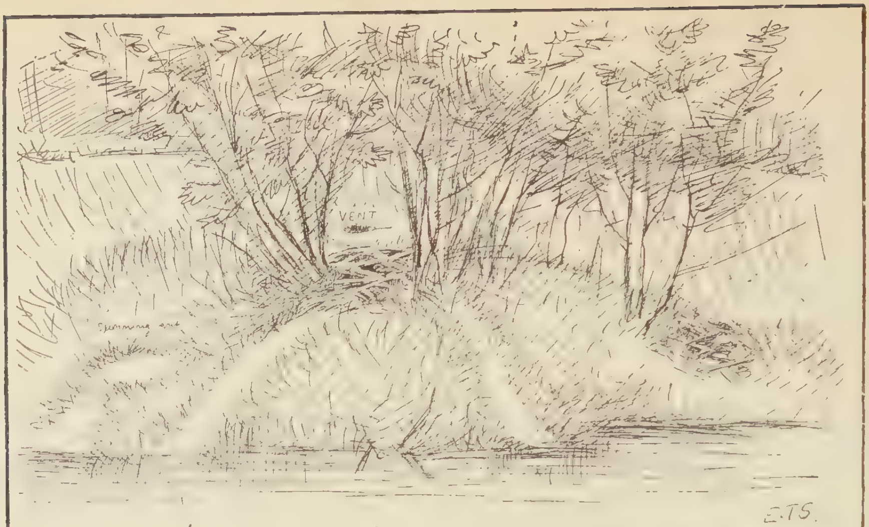
THE WITS OF AMIK

The intelligence of the Beaver has been much discussed. There was a time when it was considered on a par with that of man; and tales, marvellous and preposterous, were told in verification. A reaction set in, and it became

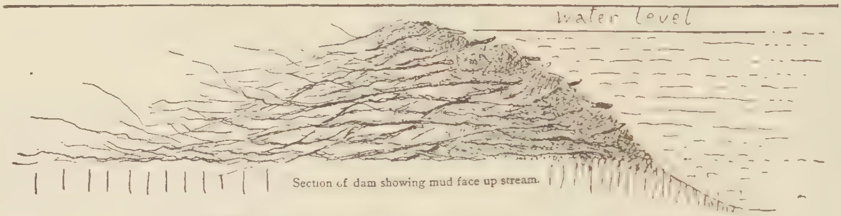
---

[111] Am. Beaver, p. 188.

[112] Days, p. 513.



Double Lodge in bank 12 yds long 4½ ft high. Nyarling R., 7 July 1907: [illegible]



Section of dam showing mud face up stream.

Beaver carrying mud on its [illegible] from photo by Josef [illegible] 1904

scratching in Wash. Zoo

1 Nov. 1926
E.T.S

Plate LIX — Beaver poses & details

generally accepted that the Beaver, being in the Rabbit and Porcupine class, was of no heavier mental calibre than they. Now, thanks to such observers as Hearne and Morgan, we are reaching the true line; and find it, as usual, in the middle of the road.

While of a low general mentality, the Beaver has a wonderfully developed instinct for the building of dams and waterways; a quickness to take advantage of little things, and a ready adaptability to change of surroundings. These aptitudes put the Beaver in the highest class of low animal intelligence—a case parallel with that of the ants indeed; which though so far down in the scale of life, have acquired extraordinarily complex instincts—instincts whose history affords one of the most wonderful "fairy tales of science."

The building of lodges, lakes, dams, and canals is the most obvious proof of the Beaver's mental gifts; but another evidence is supplied by the trappers. One of their usual modes of catching the hard-working pond-maker is by forcing a break in the dam; and in this break, setting one or more steel traps. The Beaver quickly senses the leak, and the peril of it. He sallies forth at once to make the necessary repairs—and is caught. In places of much persecution, however, he waits till black night before exposing himself.

Raymond Thompson, commenting on this, says: "A small break is made in the dam, and two or three traps set slightly to one or both sides of the break. The Beavers will attempt to repair the dam; and one, at least, should get caught. But occasionally, you will run across a trapwise old Beaver who will give you a run for your money. When you make the break in his dam, he will drag brush and mud over your traps, often burying them with a foot or more of muck. I have trapped dozens of such Beavers. Sometimes they will climb up over the dam, and attempt to mend the break from the lower side.

"But the smartest Beaver may be fooled if one goes about it intelligently, and has time to spare; providing, of course, Old Castor doesn't paddle off to parts unknown when things get too warm for him. The main secret is this: leave no sign or human scent. If you walk along a shore, leaving tracks in the mud, and making all kinds of signs where you make the set, the Beaver will know just as well what has been going on as if you had marked the exact location of the traps with a red flag."[113]

A skillful trapper has a contrivance by which the Beaver, when caught, is held down in deep water, so is speedily drowned. The inexperienced merely catch the Beaver by the leg, and so give him a chance to foot himself and escape. On this subject, Thompson remarks:

---

[113] Forest & Stream, Dec., 1925, p. 719.

"If caught in a trap fastened by ordinary methods, the animal will soon wring his foot off, and escape. The writer has caught Beavers that had been caught by all four feet at different times; both fore feet were missing, and the hind ones all scarred where they had wrenched free from the grip of the steel trap. We have never known a Beaver to wring off a hind foot, although we have caught many of them that were minus one or several hind toenails."[114]

Manly Hardy gives similar testimony. He says: "While a Beaver rarely, if ever, takes off a hind foot, he will in many cases, take off a fore foot, sometimes within a few minutes. I have seen Beaver skins which showed that the owner had lost both fore feet."[115]

Henry Bannon adds: "I was told of an inexperienced trapper whose catch for one season consisted of 3 Beaver and 17 feet."[116]

Responding to Sanctuary

In Algonquin Park, Canada, as already set forth, the Beaver have prospered mightily under the beneficent protection of the Canadian Government; and have responded, both in numbers and in behaviour, to the kindly treatment. They have become surprisingly tame. While I was there in Aug., 1922, we saw Beaver calmly feeding right in camp during late afternoon, while the sun was shining on them. On the 12th of August, about 7:30 P. M., while I was lighting the first fire, and dedicating the new Council Ring, a Beaver came out of the near stream; and at exactly 30 paces from where, with 200 campers I stood, he cut down a 4¼-inch aspen tree; then, without delay, he cut off 8 feet of the butt, and dragged the top into the stream. The boys brought in the butt piece, as the Beaver's contribution to the new Council Ring. The cutting, etc., took less than 20 minutes.

At the railway station, Aug. 21st, we found that a ranger had a young 10-pound Beaver, captured the day before. It was very tame and gentle; but had a most unpleasant way of rubbing its nose against my jugular vein, and chattering its teeth as I held it to be photographed. In the background was a new Beaver dam and pond.

Once More Diurnal

During the four centuries that our trappers have harried the simple Beaver for his clothes, they, with one voice, have described him as a furtive, shy, and strictly nocturnal animal. "No man ever saw a Beaver at work when the sun was up" is a condensation of a million tales. For this reason: all Wild Beaver photographs hitherto taken have been flash-lights.

---

[114] Forest & Stream, pp. 719–20.

[115] A Fall Hunt in Maine, Forest & Stream, May 14, 1910, p. 769.

[116] Days, p. 510.

But the inspiring success of the Yellowstone and other sanctuaries, has made us know something of the old condition. In the days which I spent at Yancey's (1897), the Beavers came to business at or before sundown. Since then, they have further improved; and are often seen hard at it when the sun is high. In all regions where well-protected, it is the same—they revert to the habit of safe days.

Henry Braithwaite says: "I have often seen them working in the daytime, especially in the spring of the year, when it freezes too hard at night for them to cut their wood. I have known them to come out of their houses at 11 o'clock in the forenoon; and it is a common thing for them to appear at 3 o'clock, and work till dark."[117]

In discussing the protected Beaver of Rocky Mountain Park, Enos Mills says: "In out-of-the-way places, where they had not been disturbed, I have seen a whole colony at work during the daytime, even when the work was not pressing."[118]

Disease and Age

Like others of our beasts, this species has its years of increase and decrease; and also is subject to diseases that are, as yet, not understood.

"In some seasons," says Richardson, "a great mortality occurs amongst the Beavers, from some unknown cause, many being found dead in their lodges."[119]

A visitation of this kind was evidently experienced in the Manitoba region about 1800. Thus, on Jan. 1, 1805, Alexander Henry abandoned his trading post at Pembina River, giving as his reason that the country was then "almost destitute of Beaver."[120] Think of it! In the best of all Beaver country, where, the year before, he had collected 1866 Beaver skins;[121] and other traders had done as well in the district. The cause of the change is not intimated, but must have been disease.

Further light on the same is supplied by Tanner, who at that time lived with the Ojibway Indians of Minnesota. He says[122] of the Beaver on Upper Red River about 1800: "Some kind of distemper was prevailing among these animals, which destroyed them in vast numbers. I found them dead and dying in the water, on the ice, and on the land; sometimes I found one that, having cut a tree half down, had died at its roots; sometimes one who had run a stick of timber half way to his lodge, was lying dead by his burden. Many of them which I opened were red and bloody about the heart. Those in large rivers and running water suffered less; almost all of those that lived in ponds and stagnant water died. Since that year, the Beaver have never been so plentiful in the country of Red River and Hudson Bay as they used formerly to be."

---

[117] Habits, p. 1.

[118] Watched, p. 131.

[119] F. B. A., I, p. 108.

[120] Quoted by E. Coues, in Henry's Journal, p. 256.

[121] As above, p. 245.

[122] As above, p. 256.

Man, doubtless, is the deadliest of this creature's enemies; but it is evident that epidemic disease is nearly as destructive in regions where the Beaver are abundant.

At 2 years, they are old enough to mate, but are not fully grown till 2½ years old. They live for 12 to 15 years. Braithwaite thinks much longer. He says: "I feel safe in saying that he is liable to live to be 25 or 30 years of age."[123]

SANITATION AND SCATS

Like all creatures that live in colonies and have elaborate homes, the Beaver has progressed well along the lines of sanitation. At all times, the lodges are found scrupulously clean; for the owner invariably steps out-of-doors when prompted to void his ordure.

The style of the scat is shown in Plate LXXVIII (p. 631). It is like a roll of fine chips and wood fibres, of light colour, and little cohesion. It will be noted that Beaver dung is not found exhibited on rocks, etc., as is that of the Muskrat. My own observations confirm those of Hearne in explanation. He says:

"In respect to the Beaver dunging . . . they always plunge into the water to do it. . . . Their dung, being of a light substance, immediately rises and floats on the surface, then separates and subsides to the bottom."[124]

I searched in vain about the Beaver pen in Washington Zoo for some dung pellets for study. And the only perfect one I found at Yancey's Ponds, was that figured in the Plate of Scats. Others, reduced to a handful of woody fibre, were found along the dam; for, curiously enough, this is a favourite spot for deposit—perhaps on the principle that every little bit helps.

FURRED AND FEATHERED FOES

If we begin at the bottom of the scale, we may reckon the Muskrat as an enemy in the sense that he is a parasite, and does some injury to the dam. Dr. Richardson says: "The Muskrat frequently inhabits the same lodge with the Beaver."[125]

---

[123] Habits, p. 2.

[124] Journey, pp. 243–44.

Eagles, no doubt, kill a few of the venturesome kits, although no record of such cases is at hand.

"The Lynx," says Braithwaite, "occasionally catches a small Beaver on the bank, but a full-grown one would be too many for him to handle."[126]

A proof of this appears in a remarkable incident furnished me by Thomas Anderson, Hudson's Bay Company Factor at Fort Smith. He says that a Desert Indian on the headwaters of the Gatineau, went out in the early spring, to look for Beaver. At a well-known pond, he saw a Lynx crouching on a log, watching a Beaver hole in the ice. The Indian waited. At length, a Beaver came up cautiously and crawled out to a near bunch of willows; the Lynx sprang, but the Beaver was well under way, and dived into the hole with the Lynx hanging to him. After a time, the Indian took a crotched pole and fished about under the ice; at last, he found something soft, and got it out. It was the Lynx drowned.

When the patient wood-cutter is wandering afar in the timber, the Fisher is another to be reckoned with, while the even more formidable Otter is ever ready to satisfy its hunger with Beaver meat, if no fish be at hand. According to Richardson, the Otter occasionally thrusts himself into the Beaver's lodge. He "is not always a civil guest, as he sometimes devours his host."[127]

As has been seen in the Wolf Life,[128] the Wolf also occasionally snaps up an unwary Beaver who ventures too far from his moat and castle.

In the Far North, the Wolverine is credited with being the most formidable natural enemy of Amik. Hearne says: "The Quiquehatches or Wolvereens are great enemies to the Beaver; and if there were a passage into their houses on the land-side, would not leave one of them alive wherever they came."[129]

But there is no such passage. And, since the enemy is not much at home in the water, we may wonder how the dry-land Wolverine can circumvent the web-footed Beaver. Only when the Beaver lands, and goes a-foraging, is he exposed to this foe's attacks. And land he must, nearly every day—or

---

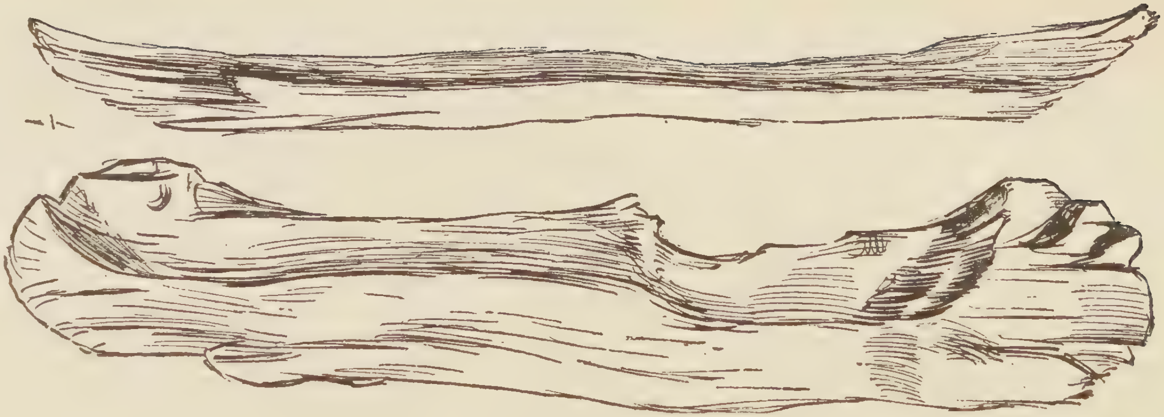
[125] Narrative, p. 92.

[126] Habits, p. 2.

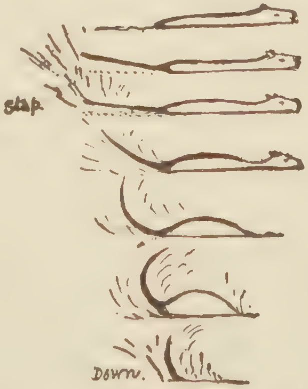
[127] Narrative, p. 92.

[128] Vol. I, p. 296.

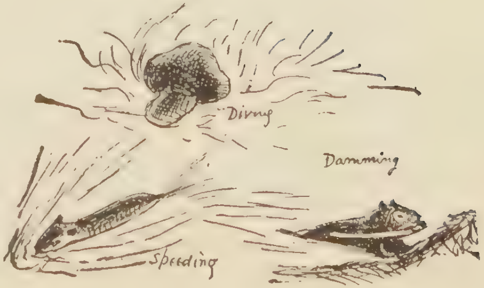
[129] Journey, p. 231.



The largest chip I saw at the Yancey Ponds (life size); many were 6 by 1 inch, but most were shorter



Succession of attitudes in diving



Life sketches of Beavers at work

PLATE LX.—CHIPS AND SPLASHES

night—for fully eight months of each year. Then, when old Web-foot is far from the friendly pond, "the Wolverine lies in wait for him, and often cuts short his career."[130] So says Gen. D. S. Stanley, who lived at Fort Sully, Dak., in the '60's, and knew the Beaver in primitive condition.

The Blackbear might take his heavy toll of the Beaver but for the deep, safe-guarding moat. Henry Braithwaite says: "I have known a [Black] Bear to go down into four feet of water, and haul a Beaver out of a trap."[131]

Enos Mills adds the Grizzly to the list. Relating the fortunes of a certain Beaver colony that he watched all season through, he says: "One day, a harvester [Beaver] who ventured far up a shallow brook was captured by a Grizzly-bear."[132]

There can be no doubt that in the Rockies, the Mountain Lion is a Beaver foe of continual menace. Nevertheless, the following, related to Mearns by an Arizona prospector, shows that the Beaver does not lie down and surrender even when confronted by a Lion. The miner, from his camp on Colorado River, saw a Beaver crossing the sand, and a Mountain Lion crouched lying in wait for it. As the Beaver approached, "the Lion sprang upon it, and the two animals closed in a desperate conflict. The fortunes of war wavered, now on the side of the Lion, anon on that of the Beaver. . . . After fighting a long time, the Beaver was left dead on the field, and the Lion attempted to crawl from the spot . . . [but] soon lay down upon the sand and died from exhaustion and loss of blood."[133] It must have been a very big Beaver, and a very small lion; however, Mearns apparently accepted the story.

All of these enemies, with their yearly toll, were provided for in the Beaver "overhead." They made little impression on the Beaver hordes, and no sum total of diminution. The Beaver millions flourished till the white man came, with his ruthless all-destroying contrivances, and insatiable greed.

Lice and Louse-trap

The coat of the Beaver seems to be infested with a troublesome parasite. The captive specimens in zoos may often be seen nibbling each other for a quarter of an hour at a time; apparently, to give and get the joy of scratching on places not easily reached by the Beaver himself.

---

[130] Amer. Nat., II, 1868, p. 215.

[131] Habits, p. 2.

[132] Watched, p. 50.

[133] Mammals of the Mexican Boundary, 1907, p. 357.

In the plan of the Lost Creek or Yancey's Pond, it will be seen that many of the short pathways end at ant-hills; these hills are the work of a small and wholly black ant (species ?) that raises its mound a foot or so above the marsh. The Beavers may have sought these hillocks as lookout places; but there was evidence of their staying a long time. I wonder if they did not go there for what is known in the West as a "dry wash"; that is, to let the ants pick off the parasites.

Possibly, as noted already, the curious split or double nail on the second toe of the hind foot, is an adaptation for combating fur-lice. Since the purpose of the split nail is still under discussion, I offer further testimony:

Enos Mills, descanting on a Beaver family he kept under continuous observation, says of the mother as she hauled up on the bank one day: "She commenced to dress her fur—to make her toilet. After preliminary scratching and clawing with a hind foot, she rose and combed with fore claws; a part of the time with both fore paws at once. Occasionally, she scratched with the double nail on the second toe of the hind foot. It is only by persistent bathing, combing, and cleaning that Beavers resist the numerous parasites which thick fur and stuffy, crowded houses encourage."[134]

Later, he tells of the father Beaver cutting down a tree, and says: "While he was gnawing, a splinter of wood wedged between his upper front teeth. This was picked out by catching it with the double nails of the second toe on the right hind foot."[135]

Vernon Bailey's remarks are even more detailed. He says: "The two inner toes, however, curve toward the body; and the nails are highly specialized, and have been called *combing claws* and *louse-catching claws*. The inner toenail is the less specialized, but consists of a long, double-edged nail that clamps down over a long, soft lobe, opening and closing like a duck's bill. The second toenail has caused much speculation, and is often called the *double-nail* or *split-nail* of the Beaver. Between the lobe of the toe and the real nail, is a horny growth with a sharp, finely serrate upper edge, over which the real nail fits down with its two sharp lower edges when pressed down, and opens up slightly when the pressure is removed. This could be called the fine-toothed comb, while the inner toe-nail is more of a coarse comb in effect.

"Never until I had tame Beavers to study, did I fully understand the use and structure of these peculiar nails, nor the reason for the incurving form of the two inner toes. My young Beavers would sit and comb their fur for a half hour at a time, making elaborate toilets when they had nothing else to do. The curved finger nails of the hands were used on certain parts of the body, around the breast and head, the base of the tail, and especially in the short hair around the anus, where the oil from the two oil glands is caught and held for distribution. These finger nails were simply raked through the fur in a coarse combing and oil-distributing process, preliminary to the final, thorough combing with the hind feet. Then, with one foot at a time, the sides, shoulders, and belly were systematically gone over with inward, rotary strokes of the two double claws of the hind toes, until every kink and snarl of the fur was straightened out, and not improbably, as Seton suggests, any mites or insect parasites combed out and off. [*Life-histories*, 1909, I, p. 447].

---

[134] Watched, p. 52.

[135] As above, p. 56.

"At any rate, Beavers are singularly free from parasites, two small brown beetles (*Leptinillus validus*) being the only ones discovered on four old Beavers taken for specimens in Wisconsin. No parasites of any kind were found on the 6 young Beavers kept in captivity, although all did much combing. Unquestionably, the early and constant use of these claws for thousands of generations has perfected their present form and adaptation; which might even suggest improved methods of caring for dressed furs."[136]

THE BEAVER'S LITTLE BROTHER

Quite a diversity of opinion prevails regarding the attitude of the Beaver toward his little brother, the Muskrat.

Richardson says: "The Muskrat frequently inhabits the same lodge with the Beaver."[137]

Apparently, the Beaver views the Muskrat as an enemy. It enters the Beaver pond as a sort of parasite, and works mischief there, as elsewhere, by piercing the dam with its tunnel. The trappers generally maintain that the Beaver recognizes the Muskrat as a mischief-maker, and kills it when the chance occurs.

Enos Mills offers some illuminating remarks: "I had often heard," he says, "that Beavers ever war upon their little brother, the Muskrat. The Beavers in this colony did not. They continued to use the old repaired house, until near the close of their harvesting. On their departure, apparently Muskrats at once took possession. But the Beavers often went back into the old house.

"One day, I saw a Beaver enter the house. There were a number of Muskrats inside. I do not know the nature of his visit, but there was no excitement. Another time, a Beaver turned aside, and touched noses with a Muskrat. Still another time, a Beaver playfully dived beneath a Muskrat. As the Beaver came up, the Muskrat grabbed Beaver fur with fore paws, and sat down on the Beaver's back. Away swam the Beaver with back above the water, little brother holding on."[138]

---

[136] The Combing Claws of the Beaver, Journ. Mamm., May, 1923, p. 78.

[137] Narrative, p. 92.

To Scatter a Mob

The blackbirds that frequent the Beaver pond, and find safe nesting places in the willows, may be considered modest parasites of the Beaver, much as were the jackdaws perching about and nesting in the feudal baron's castle. The blackbirds do not realize their debt to the Beavers; their ill-behaviour toward their benefactors in the Yancey colony at times constituted a nuisance.

The patriarch and chief toiler in the big pond, while attending strictly to business, was continually pursued by the Brewer blackbirds that nested in the near-by swamp—*his* swamp, made by *his* efforts. They were very inconsiderate, ungrateful, and resentful birds, ready to annoy any creature that came near their home ground. Without regard to law or order, age, rank or prior claim, they again and again united in a noisy mob to tease the old Beaver as he calmly swam across his own pond. But sturdy old Amik found a simple way of dispersing the mob, one that I would commend to the notice of our city authorities. When tired of the annoyance, he gave a flirt of his tail that sent up a shower of spray on his tormentors, and drenched them so thoroughly that they were glad to go back to the bushes and mind their own business.

As an Irrigator

The Beaver's services as a water conservator are not fully appreciated. George B. Grinnell tells[139] of a little valley in Montana where to-day the Beaver are numerous, although the region about is trapped out. The settler on whose land it is, protects the Beaver colony rigorously.

"The reason that these Beaver are protected," says Grinnell, "is that the man who claims this water and the adjacent hay meadow, realizes that in the Beaver he has a lot of unpaid servants, who, by their work, are saving him a great deal of labour and of money. They have dammed this creek, and have thus put under irrigation the meadows from which he cuts his hay. If he were short-sighted enough to tear up these dams and to kill these

---

[138] Watched, pp. 136–37.

[139] Forest & Stream, Jan. 19, 1907, p. 95.

Beaver, he would be obliged to go to the head of the stream, and there take out a ditch, bring it around along the hillsides, build laterals and sub-laterals, and so get water on his hay meadows at considerable expense. Now, that meadow is sub-irrigated throughout its whole length, receiving just the amount of water that it needs; and all this without one cent of cost to him who cuts his hay there."

Many a dry farmer in the West is now utilizing the Beaver's services in this way. I am in hopes that this setting forth of the method, will result in many others adopting it. It gives a new interest and a new value to the Beaver.

Beaver and Trout

The Beaver dam turns the rill into a succession of pools, cool and deep. In these, the trout find safety, especially when, in dry times, the rill ceases to run. They seem to recognize the Beaver as friend and protector.

This story is told by W. C. Vogt, and appears in *Field & Stream*, March, 1921, p. 1004: For several evenings he watched some trout in a pool below a little fall. They were, he says, "lying directly under the belly of a large Beaver. . . . I'd step out from behind the bushes, and they would disappear, but return in a few moments; they didn't seem to pay any attention to the Beaver until I made a cast and hooked the Beaver in the ear with my fly. When he felt the sharp point of the hook, the old boy slapped the water so hard it sounded like a man striking the water with a paddle with all his might. You should have seen those trout go, also the Beaver. He straightened out the fly hook, but came back again in ten minutes, the trout with him.

"Seemed to me the trout were sort of guided by the Beaver's actions. I gently laid the leader across his head, and he shook his head like an old bull. I struck and hooked his ear; again he made a plunge, and splash that looked as though a small cannonball struck the water. The trout went with him again; and in about twenty minutes, he returned, the trout with him—six beauties. I made another cast, across his tail, and struck; and I thought sure he had broken my rod, but found he had again straightened out the fly hook.

"I waited half an hour or so, but he never came back. It was getting dark, and I was sort of sorry I broke up his trout party. I'll always remember his big eyes, like big, brown, glassy marbles. I saw several [Beaver] climbing over a dam a little distance up from where I stood, and maybe he was among them. There are thousands of men who believe that Beaver catch and eat trout."

The Chain

Darwin is credited with saying that the fertility of the clover crop in a given region depends on the number of old maids there. The clover relies wholly for its fertilization on the bumblebee; the bumblebee's deadliest enemy is the Field-mouse; the Field-mouse finds his effectual check in the Cat; and the number of Cats depends on the number of old maids. Q. E. D.

Such unexpected yet undeniable chains are discoverable in the animal world, if we look for them. Thus, I have heard Dr. Robert T. Morris hold that cotton overalls had multiplied the Caribou in Labrador. How? Simply thus: Cotton clothing, brought by the white-men, was so cheap and strong that the natives gladly traded off the valuable Caribou skins that should have afforded them weatherproof clothing, and adopted cotton garments. But wet overalls are a fruitful source of colds, and the natives were so prone to lung trouble, that the cotton clothing proved devastating. The hunters especially were stricken; and, in the resultant decline of hunting, the Caribou prospered.

Indian wars, freaks of fashion, new uses, have each in turn had a bearing on the animal whose product was involved. In the case of the Beaver, its fur was so much in demand in making the necessary beaver hat of respectability, that the creature seemed doomed. Then respite came from the discovery that silk made a better looking hat; so silk hats took the lead, and, for a time, the Beaver was reprieved.

The Moated Castle

There is one aspect of the Beaver lodge that deserves the full and careful attention of some trained naturalist, that is, as a moated citadel, the home of a community.

The baronial castle of the Dark Ages, was, first of all, the moat-surrounded, thick-walled dwelling place of the manor-lord and his family. But so many other weaker persons were eager to seek his protection, that each castle became an ever-growing community, comprising the strangest and most diverse types.

This is exactly the case of the Beaver lodge. First, the great over-lord and his family build their strong fortress, of reinforced concrete—that is, sticks and hardening mud—and, at the same time, they dig and dam till the deep moat is all about it.

The moat entirely changes the aquatic life. New plants, new fishes, new insects are attracted. The top of the lodge furnishes a secure nesting place for wild geese, wild ducks, divers, grebes, etc.; the hollows in the great walls afford refuge to Water-shrews, snakes, Mink, and Muskrats. Fish lurk in the dungeons below, while insects, of kinds all too many, flourish in the wall, the roof, and the bedding.

The full story is worth a summer's work at least. Where is the young naturalist who will set forth in full this untold fairy tale?

PLACE IN HISTORY

First known, best known, and most important historically of all the big animals in America, is the Beaver. More than any other, it changed the course of history; more than any other, it has been studied and discussed. The bibliography of the Beaver far exceeds that of any other of our animals. It is the only species that has been made the subject of half a dozen monographic works.

In view of this, it seems presumptuous to treat in 50 pages what others have done so much better in whole volumes. Therefore, let this be considered rather a résumé of the subject, with references and appraisals of its extensive literature.

The earliest known game law in America was established by the Redmen for the protection of the Beaver. From Samuel G. Drake's "Indian Biography" (1832, p. 111), we learn that in 1684, De la Barre, Governor of Canada, complained that the Iroquois were encroaching on the country of Indians who were allies of the French. He got a stinging reply from Garangula, the Onondaga Chief, and a general statement that *the aborigines had game laws;* not written, indeed, but well known, and enforced with a club if need be: "We knock the Twightwies [Miamis] and the Chictaghicks [Illinois] on the head, because they had cut down the trees of peace, which were the limits of our country. They have hunted Beaver on our lands. They have acted contrary to the customs of all Indians, for they left none of the Beavers alive, they killed both male and female."

For four hundred years, we pursued the defenseless Beaver with ruthless extirpatory slaughter. Fortunately, before the consummation of our reckless activity, we have wakened up; we have realized the gravity of the impending loss. We have become almost as advanced and far-sighted as the Redmen were 300 years ago; and have enacted protective laws that will insure to us a supply of Beaver for the indefinite future.

There can be no doubt that the Beaver did more to open up Canada than any other creature or product. It was the pursuit of the Beaver that lured on the early explorers, and that brought here the original colonists.

It was Beaver fur that bought for white-men the manufactures of Europe which were needed to make life tolerable, when first our people took to the woods. It is fitting indeed that this creature, the symbol of energy, peace, and industry, should be the emblem of the Canada for which it did so much.

REFERENCES

1795—A Journey from Prince of Wales' Fort in Hudson's Bay to the Northern Ocean, by Samuel Hearne, London, 4^0, 458 pp., ills.

> This standard work on Northern life and natural history is blemished by a total lack of index or adequate table of contents. The Beaver matter, the first published reliable account of the Beaver, covers pages 226 to 246; and yet has no place by title in the synopsis of the chapter, or anywhere—here or elsewhere—by caption or hint of its existence. Dr. John Richardson, in his famous "Fauna Boreali Americana," gives little of his own concerning the Beaver; and, for explanation, says: "The best account of the manners of the Beaver, and the most free of extravagancies, is that given by Hearne; and it agrees so exactly with the information I received from the Indian hunters that, were I to record the latter, it would appear to be borrowed almost entirely from that traveller. I therefore prefer giving it in Hearne's own words."[140]

1799-1814—New Light on the Early History of the Greater Northwest, Alex. Henry's Journal, etc., pub. 1897, edited by E. Coues. Cited herein as Henry's *Journal.*

1823—Narrative of a Journey to the Shores of the Polar Sea, by Capt. John Franklin. In this, the natural history part was written by Dr. John Richardson, who accompanied the expedition.

1829—Fauna Boreali-Americana, by Dr. John Richardson, I, pp. 105-13.

1849—Quadrupeds of North America, by Audubon and Bachman, I, pp. 347-59; 1 ill.

1868—The American Beaver and His Works, by Lewis H. Morgan, Phila., 330 pp., many ills.

1892—Castorologia, or the History and Tradition of the Canadian Beaver, by Horace T. Martin, 8vo, 238 pp., 54 ills.

1897—The Beaver Pond, by E. T. Seton; Pt. II of Elkland; *Recreation*, Oct., pp. 286-90. 12 ills.

1901—The Habits of the Beaver, as told by Henry Braithwaite to the late Frank H. Risteen, *Rod & Gun in Canada*, Montreal, Aug.

1903—Mammals of Pennsylvania and New Jersey, by Samuel N. Rhoads, pp. 67-77 and 223.

[1914]—The Romance of the Beaver, by Arthur Radclyffe Dugmore, 225 pp., many ills., but no date!

---

[140] F. B. A., I, pp. 108-09.

1922—Watched by Wild Animals, by Enos A. Mills.

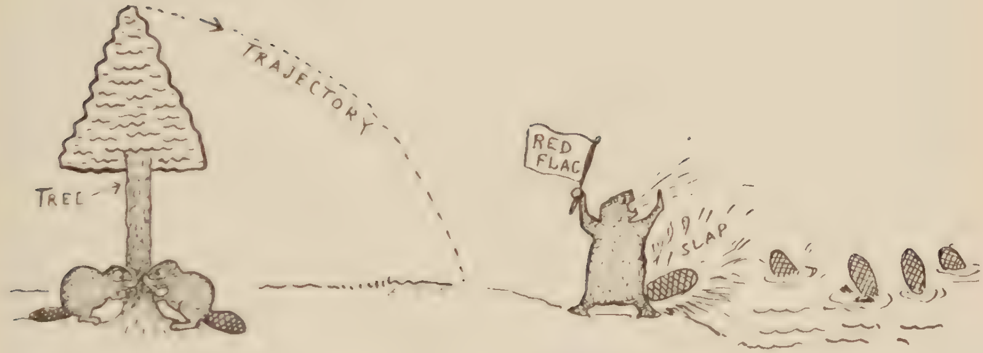
1922—An Investigation of the Beaver in Herkimer and Hamilton counties of the Adirondacks, by Dr. Charles E. Johnson, Roosevelt Wild Life Bulletin, pp. 117–86, many ills., 2 maps.

1922—The Life of the Yellowstone Beaver, by Edward R. Warren, pp. 187 to 221 of the above; many ills., 1 map.

1922—Days with a Beaver Trapper, by Henry Bannon, *Forest & Stream*, Nov., pp. 486–87 and 510–17.

1922—Beaver Habits, Beaver Control, and Possibilities in Beaver Farming, by Vernon Bailey, U. S. Dept. Agri. Bull. 1078, 31 pp., many ills.

1923—Johnny and Paddy, Two Baby Beavers, by Vernon and Florence Merriam Bailey, *Nature Mag.*, Jan., pp. 3–7; several ills.



LIFE LXXXVI—THE PACKRAT

PAGE
Names 504
Description: Size, Weight, Colour 504
Races 505
Range and Haunts 506
Abundance 506
Erratic Migration 506
Packrat Broth, Etc. 508
His Foes 510
Warbles 511
Sociability and Signalling 511
Disposition and Habits 512
The Secrets of His Mound 513
The Horror of Wild Fire 515
Home Love 516
The Mating and Breeding 517
A Long Food List 518
Storage Habit 519
His Museum 520
As Trader 522
Who Will Tell Us? 522

References 523

Packrat, Trade-rat, Mountain Rat, Cave-rat, Wood-rat, Bush-rat, Bushy-tailed Rat, Mound-builder, Drummer-rat

Neotoma cinerea (Ord)

(Gr. *neos*, new; *temno*, to cut, in allusion to the teeth; L. *cinerea*, ashy)

Mus cinereus Ord, 1815, Guthrie's Geog., 2d Amer. Ed., II, p. 292.
Neotoma cinerea Baird, 1857, Mamm., N. A., p. 499.

Type Locality—Near Great Falls, Cascade Co., Mont.

Hopi, *Kee-huá Cahl'-a.*[1]

The name "Packrat" is, of course, from the Western word "pack," meaning to "carry" or "carry off." "Trade-rat," referring to its habit of leaving something in place of the alluring object it carries off, is explained in the section, "As Trader."

The genus *Neotoma* (Say & Ord, 1825) is composed of rodents of ratlike size and form, with more or less hairy tails, and peculiar teeth.

$$\text{Teeth: Inc. } \frac{1-1}{1-1}; \text{ mol. } \frac{3-3}{3-3} = 16$$

Major E. A. Goldman's Revision of the Wood-rats[2] recognizes 70 species and subspecies. These he groups into 3 subgenera—*Neotoma*, *Homodontomys*, and *Teonoma* or, in English, Roundtailed Wood-rats, Dusky-footed Wood-rats, and Bushy-tailed Wood-rats or Packrats.

The last is the best known, the largest, most clearly marked, and most widely distributed; so may represent the group, since, in their habits, they closely resemble each other.

In addition to the generic characters, the Packrat has the following:

Size. Length, 15¼ in. (387 mm.); tail, 6⅜ in. (162 mm.); hind foot, 1 11/16 in. (43 mm.).

---

[1] Mearns, Mamm. Mex. Bd., p. 479.

[2] N. A. F., 31, 1910.

Weight. Two females taken in New Mexico, Jan. 27, 1894, weighed each ½ lb.

Colour. The first impression is of a warm buffy brown animal, with snowy-white breast and underparts, and bushy gray tail.

In general, above, soft buffy-brown, faintly but thickly lined with dark tips. The buff becomes clear and deeper on shoulder, flank, and ham, but paler on face. Lips, throat, underparts, paws, and underside of tail, creamy white. The upper surface of tail is dark gray. The central area of belly, 4 in. long by 1½ in. wide, stained yellowish with the musk. The longest whiskers are 4 in.; they are black and white mixed. The ear is dark gray. The eyes are large and black.

The young are much less buffy, more gray; also the underfur on their belly is plumbaceous instead of white.

The female is like the male, but without the musky stain on the belly. The teats are 4, all inguinal.

The bushy tail is a strong feature, distinguishing it from the Round-tailed group, and the Dusky-foots.

Races

cinerea Ord, the typical form. T. l., near Great Falls, Mont.

lucida Goldman, like *cinerea*, but smaller and paler; smallest of all the Packrats. T. l., Charleston Peak, Clark Co., Nev.

drummondii Richardson, like *cinerea*, but fur longer, tail bushier; and the dark colour of the fore legs ends sharply at the wrists. T. l., Near Jasper House, Alta.

saxamans Osgood, like *cinerea*, but much darker, and with much bushier tail. T. l., Bennett City, B. C.

occidentalis Baird, like *cinerea*, but darker, and ankles more dusky. T. l., Shoalwater Bay, Pacific Co., Wash.

fusca True, like *cinerea*, but much darker and woollier; ears smaller; top of foot, dusky; tail bushy, and not white below. T. l., Fort Umpqua, Douglas Co., Ore.

orolestes Merriam, like *cinerea*, but more ochraceous; larger than the two following. T. l., Saguache Valley, Saguache Co., Colo.

arizonæ Merriam, like *cinerea*, but much smaller, and more ochraceous; tail less bushy; paler and smaller than *orolestes*. T. l., Keams Canyon, Apache Co., Ariz.

rupicola Allen, like *cinerea*, but smaller and paler; tail, shorter. T. l., Pine Ridge, S. D.

RANGE AND HAUNTS

Map XIV (p. 507) is based on Goldman's maps in the Revision. It shows that this is essentially a mountain Rat, infesting the upland region of the Rockies, from Colorado and California to Yukon; and extending its possessions southward along the Sierra Nevada of California, also into Arizona and into New Mexico; where high, cold cliffs or canyons carry the Canadian conditions into the Transition Zone. It does not reach the upper limit of the Canadian.

In all this vast range, it is found wherever there is a combination of trees or bushes, rocky cliffs, rock slides, caves and crannies, near water and evergreen trees. In its haunts, it is essentially ratlike, rather than squirrel-like, although there is much of the latter in its habits.

Fortunately, it does not frequent towns; and the only encroachment it makes on the abodes of man is among lonely ranchhouses and in miners' cabins.

ABUNDANCE

Various writers describe the creature as "abundant," "plentiful," and "common everywhere."

When at Victorville, Calif., Feb. 13, 1923, I rambled over the 50-acre tract to the east of the ranchhouses, and noted a Packrat house about every 30 feet; that is, 1 to 1,000 square feet, which would mean about 40 to the acre. This was doubtless *fuscipes*, as it was on the Mohave Desert.

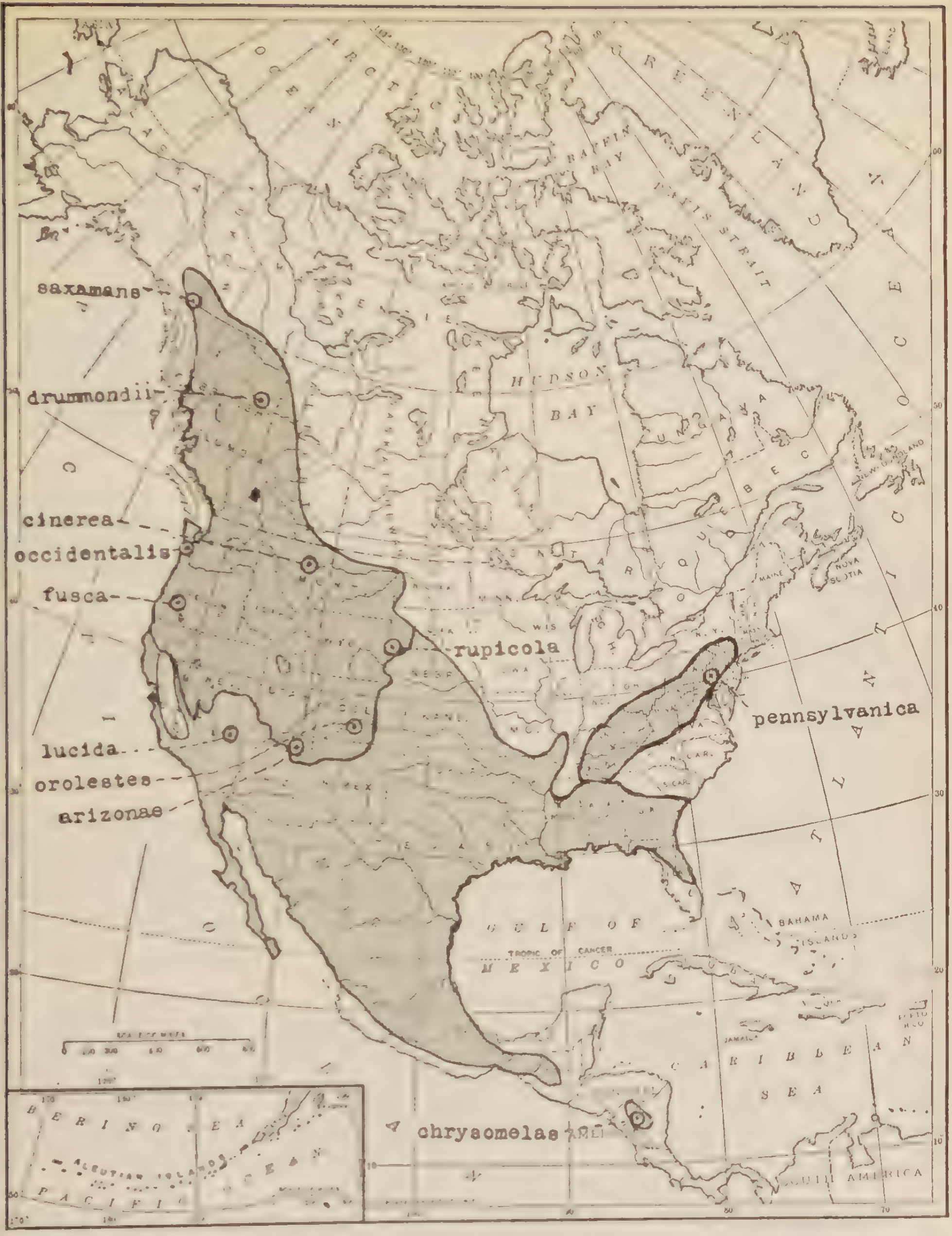
In the region about Clayton, N. M., I found the local species (*albigula*) nearly as common. The masses of rubbish, as high as a man, were visible in all directions, sometimes as many as a dozen to the acre.

ERRATIC MIGRATION

The species is supposed to be stationary throughout its range. Doubtless, it is so, in the ordinary sense; but there is evidence of the same sort of erratic migration as appears among Gray-squirrels, Lemmings, etc. Such movements are sometimes called "drifts."

Referring to the species in Oregon, A. W. Anthony says: "By far the most interesting 'drifter' is the Western Bushy-tailed Wood-rat (*Neotoma cinerea occidentalis*). There would seem to be an extensive and regular movement of this species, beginning each year in early July, and extending over a period of about five weeks.

"In 1912, I trapped 25 Rats in my barn in some three weeks; and then resigned in favour of my son, H. E. Anthony, who soon extended the record to 40. At no time was there evidence of more than 2 or 3 Rats on the place;



MAP XIV.—RANGE OF THE ROCKY MOUNTAIN PACKRAT (*N. cinerea*) AND ITS ALLIES

By E. T. Seton, with assistance of the Biological Survey, 1927

The Packrats of various species are found in all of the tinted area.

The Bushy-tailed or Mountain Packrat in various forms is found in the mountain region of the Northwest, here heavily tinted.

and after the last was captured, some time in August, I think there were none seen until the following July.

"In later years, I noticed one or two Wood-rats at about the same date; and a steady movement was noted until about the middle of August. If a pair were trapped, it was seldom over 24 hours before more appeared; but it was seldom, if ever, that we were annoyed by their depredations after their movements had ceased in August.

"At the time these movements take place, food is still to be had in its usual abundance; and the mating season has long since passed. It would seem to be chiefly an instinct to seek new habitats before winter shuts them in, and one which serves as a check on consanguinity and its evil effects."[3]

PACKRAT BROTH, ETC.

Of the Packrat's flesh, all speak in praise. Despite the musky smell of the living animal, the flesh is delicate and sweet, and has long provided a staple of diet to many of the human residents of its range.

Thus Mearns says: "Indians kill and eat them. The Hopi . . . pronounce its flesh a delicacy. Captain Martinez, of the army engineers corps of Mexico, informed me that physicians of northern Mexico commonly order broth made from the Wood-rat for the Indians and peasants, whom they are called upon to treat; just as our physicians prescribe chicken broth and beef tea."[4]

So also Nelson writes: "They are persistently hunted as game by the [Mexican] natives, who prize them as a special delicacy. I saw them regularly sold in the markets of the cities of San Luis Potosi and Aguas Calientes, where the method of marketing them was unique. As soon as they were dug from their nests, their lower incisors were broken off close to the jaw to render them powerless to bite; and then the Rats were placed alive in a strong sack and carried to town.

"The vendor would sit on the curb of the market, and either kill and dress them there, or shout his wares by telling everyone who passed that he had 'country Rats; very delicious; live ones; fat ones; very delicious; very cheap.' The natives all praised their delicate flavour; and one I had served me as a special courtesy, was really good, tasting like young Rabbit."[5]

Although his fur is soft and warm, as well as of pretty colour, it has not yet established a place for itself in the world of commerce. Doubtless, it will not be overlooked much longer, if it can be obtained in quantity; since

---

[3] Journ. Mamm., Feb., 1923, pp. 60–61.

[4] Mamm. Mex. Bd., p. 479.

[5] W. A. N. A., p. 517.

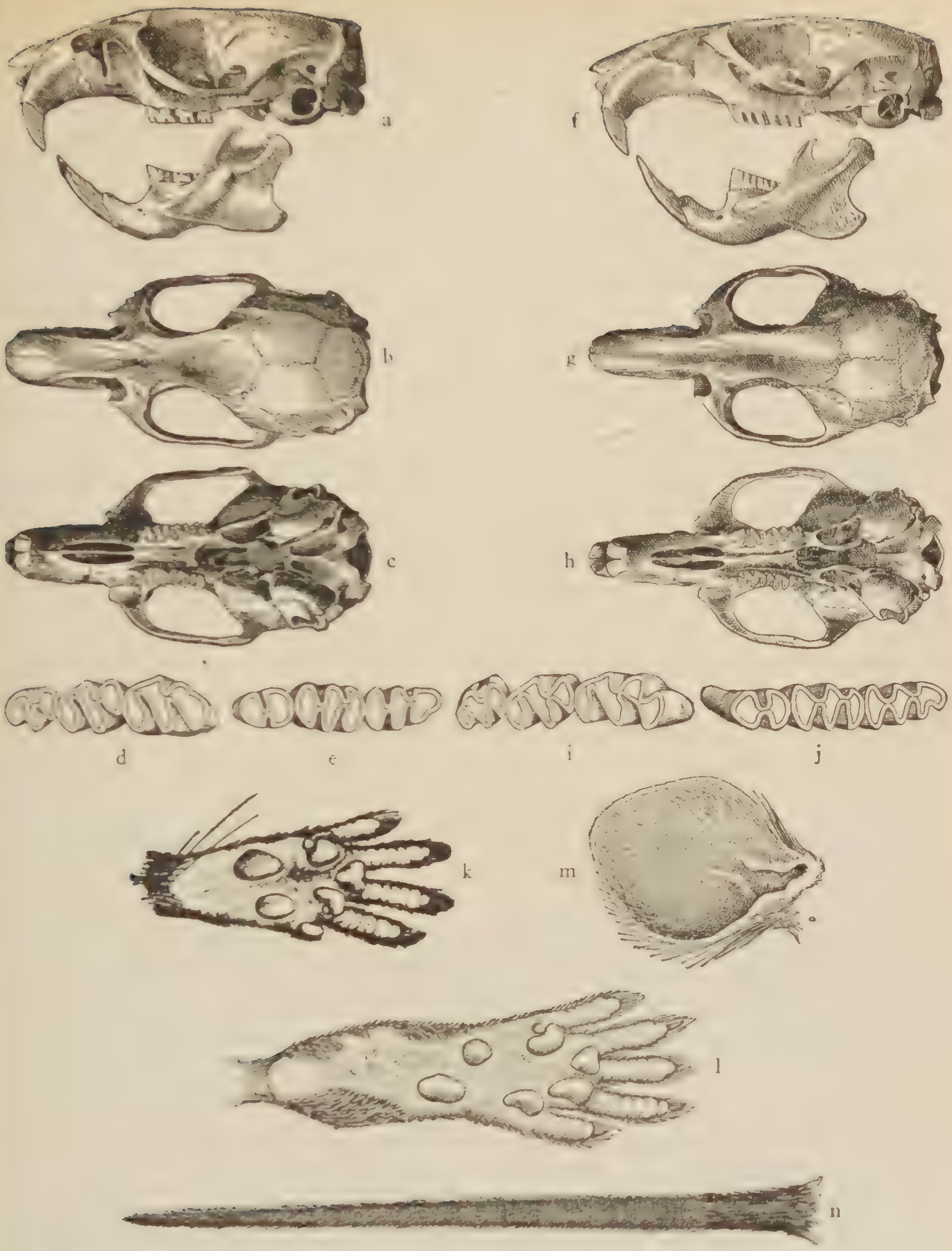


PLATE LXIII.—SKULLS, ETC., OF NEOTOMA

(a, b, c) Skull $\frac{1}{1}$ of *Neotoma cumulator*, (d, e) teeth of same, $\frac{4}{1}$. (f, g, h) Skull $\frac{1}{1}$ of *Neotoma pinetorum;* (i, j) teeth of same, $\frac{4}{1}$. *N. fuscipes macrotis* (k, l) Feet, $\frac{3}{2}$; (m) Ear $\frac{1}{1}$; (n) Tail $\frac{2}{3}$.

These cuts are from Mearns's *Mammals of the Mexican Boundary*, and supplied by the U. S. National Museum every kind of peltry known—Cat, Rat, Rabbit, Colt, or Calf—is used; provided only it have some hint or semblance of fur.

HIS FOES

Every predaceous bird and beast in his region preys on the Packrat. Wildcat, Lynx, Coyote, Wolf, Badger, Skunk, hawk, and owl, lose not a chance to banquet on his tender flesh.

Speaking of the White-throated species, Mearns says: "Hawks and owls also devour this Rat. A Western red-tailed hawk, taken Jan. 16, 1887, at Fort Verde, had eaten one, swallowing it, bones, hair and all. Barn-owl pellets from a nest in the bluff clay bank of the Verde River, on July 30, 1885, contained bones of this Wood-rat."[6]

Bailey says: "The skulls are among the commonest bones recognized in pellets under the cliffs where the great horned owls roost."[7]

On Aug., 16, 1927, when camped at Laguna, N. M., Carol Stryker and myself found a number of horned owl pellets composed of Packrat bones and fur. .

From most of these foes, he is secure in his piled-up, spiny, barricaded nest. Yet there be one or two who can take the castle by invasion or assault. Leaving out man, the Badger and the Bears are the only creatures strong enough to tear down the cactus battlements of Kee-hua's castle; but so far, we have no testimony that they ever face this serious task.

The Weasel and the snake can take it by invasion. There is not a definite record at hand of slaughter by Weasels; but many naturalists bear witness to the toll taken by snakes.

Discussing a nest of *fuscipes* that was on a rocky ledge in Santa Cruz Mountains, Calif., Harold E. Parks says: "One of the occupants was a very long, slender snake—probably a California striped racer—which proceeded to race back and forth through some brush, but I could not make it leave the vicinity of the nest. It is said that rattlers sometimes use these nests; but although I have had some painful experiences in trying to prove it, I have never found the rattler in the nest. If the rattler occupies the nest, he also eats the Rats."[8]

Mearns adds: "On Aug. 15, 1886, at Fort Verde, the First Sergeant of Company K, Ninth Infantry, brought me a diamond rattlesnake weighing $4\frac{9}{16}$ pounds, which contained a Wood-rat."[9]

---

[6] Mamm. Mex. Bd., p. 479.

[7] Texas, p. 112.

[8] Santa Cruz, p. 247.

[9] Mamm. Mex. Bd., p. 479.

That the snake does not have an assured or easy victory, is attested by Prof. Carl Hartman, of the University of Texas, who says: "Sometimes possession of the nest is successfully disputed by rattlesnakes, which formerly infested the Driscoll Ranch (now in cultivation) 25 miles southeast of Austin, where the observation was made. Mr. [Charles H.] Hamby describes the Rat as the chief aggressor in the battle witnessed by him. The snake never struck, but confined its activities chiefly to attempts at escaping. It would coil up while the Rat would stalk round and round, until a favourable opportunity presented itself, when the Rat would pounce upon the coiled mass and bite furiously. Thereupon, the snake would attempt to escape, only to coil up again for defence. This procedure was repeated until the snake collapsed; and even after this, the Rat bit the snake a dozen times before leaving the field of battle. During the fight, both snake and Rat seemed perfectly oblivious of the observer's presence."[10]

Something like an armed neutrality is hinted at in Cope's comment. After discussing the Prairie-dog as a home-provider for the rattlesnake, the Professor adds: "In some regions, the Wild Rat, *Neotoma*, does the same service. I well remember a large *Crotalus* which dwelt in apparent harmony with a Rat and her family near a camp north of Clarendon, in the Panhandle of Texas. Both the snake and the Rat were fat; but no young Rats were in sight."[11]

WARBLES

The Packrat would be alone in his Family if he escaped the pesterment of the bot-fly. Edmund C. Jaeger, of Riverside, Calif., says: "On March 2, 1924, I caught a male in a box trap, and found him to be the host of larval bot-flies, as evidenced by great blisters on the back and sides of the abdomen. The larvæ at this time, were just about ready to emerge, and drop for pupation. The animal, formerly very fat, seemed considerably reduced in weight; but was very active. Three weeks later, I caught a female; and scars indicated that she had previously had 'warbles' too."[12]

SOCIABILITY AND SIGNALLING

There is much evidence of well-developed sociability among these animals. Parks says of the White-throated species: "They appear to be sociable by nature. In one case, I found evidence of two families occupying one large nest. Frequently, hard and well-worn paths will be found leading from one nest to another, indicating intercourse between them. Usually the nests are to be found in colonies, isolated nests being exceptions."[13]

---

[10] Journ. Mamm., May, 1922, p. 117.

[11] Ann. Rep. Smiths. Inst., 1900, p. 1173.

[12] Journ. Mamm., Nov., 1924, p. 268.

Drumming as a mode of signalling or of expression is practised by many animals; for example, Deer-mice, Rabbits, and Hares. But it would seem that the Wood-rats have developed the method more highly than most of those mentioned.

Merle F. Bancroft says of the British Columbia species, as he saw it near Ashcroft, "I was sleeping on a camp cot; and, in the gray dawn, heard a rapid beating on the board floor beneath my cot. Quickly ducking my head over the side of the cot, I got my first close-up glimpse of a Wood-rat. . . . This particular Wood-rat had become adept in drumming on a board floor. The noise produced was far louder than ground drumming."[14]

Nelson also testifies that Wood-rats "express annoyance or alarm by a rapid drumming on the ground with the hind feet."[15]

Like White-footed Mice and blacksnakes, they are known at times to drum with their tails also.

The species is noted for its strong, musky smell. A. Brazier Howel found on the belly of the male an area about $1\frac{1}{4}$ inches by 3, occupied by sebaceous glands, the source, no doubt, of the musky smell; but he did not find them in the female.[16] Such muskiness is usually considered part of a system of communication; being used either as a property-mark, a sign-board, or a wireless call. Nevertheless, no observations are yet at hand to show that it serves the species in any of these ways.

Bailey says: "A strong, musky odour, characteristic of the genus, is the usual indication that the dens are inhabited."[17]

DISPOSITION AND HABITS

A singular combination of shyness and boldness, courage and timidity, cunning and simplicity, are seen in the character of the Packrat. But the shyness and timidity and simplicity are dominant, warning us that, in the long run, this interesting species must give place to the fierce and crafty Brown Rat of Europe.

---

[13] Santa Cruz., p. 244.

[14] Can. Field Nat., May, 1922, p. 87.

[15] W. A. N. A., p. 517.

[16] Anatomy of the Wood-rat, 1926, pp. 16–17.

[17] Texas, p. 114.

All of the group can climb well, but *fuscipes* is more at home in the trees than its kinsfolk. Of this, Parks says: "On the ground, they were slow of movement, but were much speedier in the trees. Aloft in the trees, they were not inclined to run far or escape when observed. They would stretch their bodies lengthwise along a limb without much attempt at concealment, and then follow every movement of a person on the ground with their eyes. Unlike the Squirrels, they do not seek to keep the tree between themselves and an observer. When shot at with a rifle, they would sit up on their haunches, and squeal; but make no attempt to run away."[18]

"One morning," he continues, in discussing the species, "while at an early breakfast, under the trees at my camp, I noted a considerable commotion in the branches overhead. A half dozen small animals were running back and forth at play, unconscious of or unconcerned at my presence. I did not attempt to destroy them at this time; and in several days, they became quite tame, showing no fear of any one around the camp. They appeared regularly morning and evening; and quite frequently came down to the ground for bits of food.

"To me, they appeared quite stupid, and rather sluggish in movement. They did not move with any great speed; and such of them as I have seen at distances from the nests, did not take alarm very easily. It may be that their great curiosity overcomes fear to a certain degree.

"Eventually, these little visitors became such a nuisance that the rifle was brought into use. Sitting at my table, I shot 6 of them as they sat in the branches of the tree above me. They made no effort to get away, simply squealing a little at the noise, but otherwise appearing quite unafraid. They presented a ludicrous and helpless appearance.

"They were all apparently dwellers in a nest located in a large oak at some little distance from the camp. I could trace their course of travel through the trees from that vicinity. I have since seen regular courses travelled by Rats through the madrone thickets, regular paths being worn in the tender young green bark early in the fall."[19]

THE SECRETS OF HIS MOUND

The outstanding, visible, and omnipresent evidence of the Packrat's presence is the nest. This is a vast and growing pile of sticks, stones, leaves, pine cones, cactus, thorns, bones, cow-dung, bark, rubbish, and trash galore. The Rat weighs half a pound; the mound weighs half a ton.

---

[18] Santa Cruz, p. 243.

[19] As above, pp. 242–43.

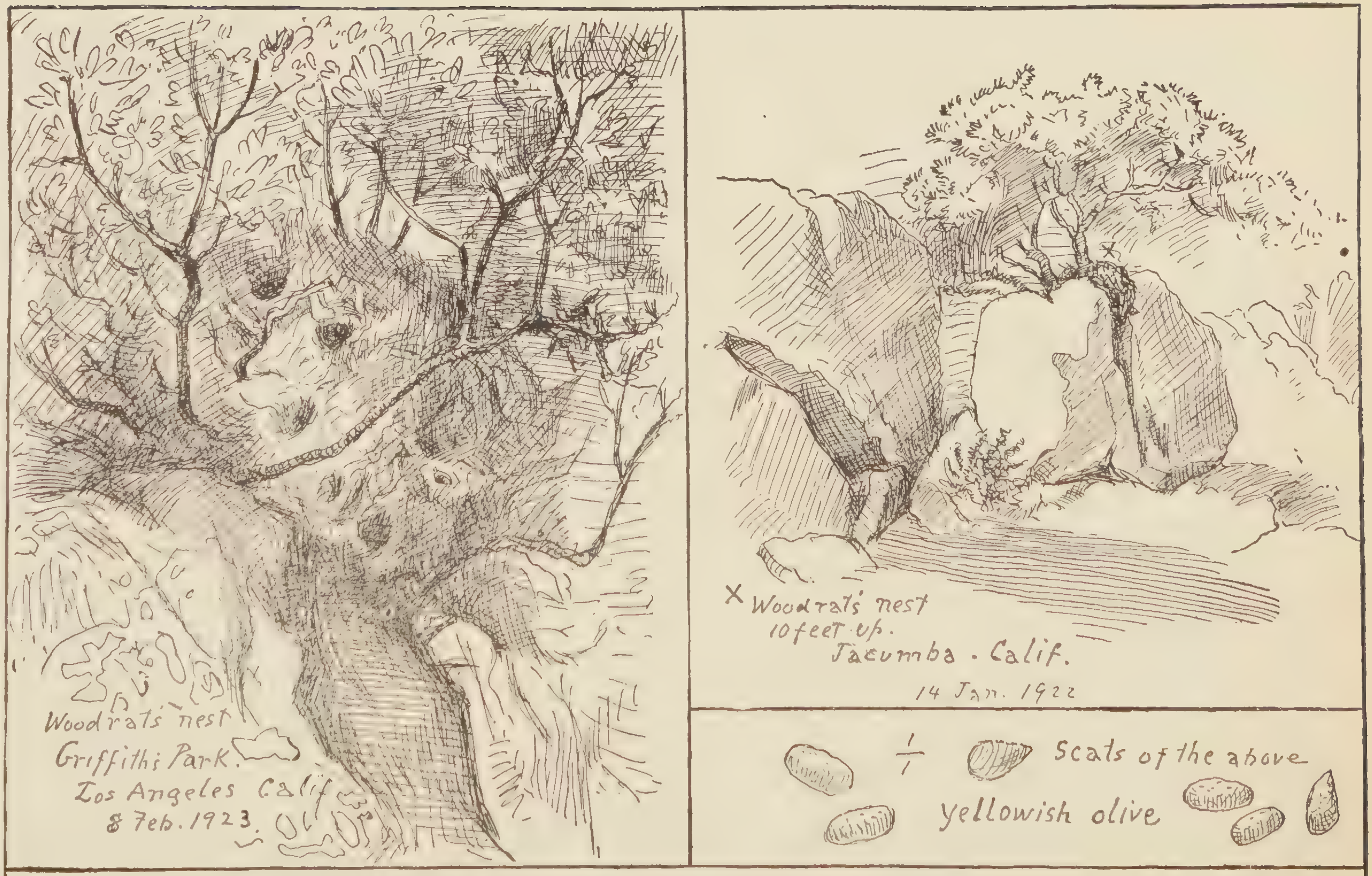


Plate LXV – Nests of Neotoma – tree & rock; both in California.

The cactus or other spines are a dominating feature of the mound. They fringe and protect it everywhere, and are especially thick and dangerous around the doorways, as we know to our cost whenever trying to force an entrance.

Bailey says: "How the Rats can run over these houses and along the trails strewn with cactus spines, and never show a scratch on the bare, pink and white soles of their feet, is a mystery."[20]

In the centre of this mound is the real nest—a long chamber about 5 inches across and 3 high. It is lined, roofed, and floored with a mass of the finest available shreddings—usually chewed cedar bark—but also some hay, hair, feathers, and fur, with cotton and rags when available.

The outer walls may be rugged and spiney, but this innermost sanctuary is always a model of cosiness and soft comfort.

There are several entrances, most of them visible and aboveground; but the prudent mound-builder always has a cyclone cellar into which he can retreat in times of unusual stress.

Speaking of the large nests of *fuscipes*, Pennoyer F. English says that they vary from 2 to 8 feet both in height and diameter; these "large nests . . . are divided into as many as 5 compartments, these being used as nursery, living room, and storage chambers—and one place is used for the depositing of dung. The inner compartments are connected by a series of runways."[21]

The nest of the Packrat, like the dam of the Beaver, is never finished. As long as he lives there, the sedulous little one keeps piling on new material; and he will live there as long as fate lets him. Not a night passes without additional sticks and rubbish being added; so that, as the years go by, the nest becomes a little mountain composed of a ton or more of trash.

THE HORROR OF WILD FIRE

There is one menace to the nest and to the Rats, that has always loomed large, as far back as history goes—whether before that, is uncertain. That menace is wild-fire. In seasons of drought, the fires which sweep the forest and mesas of the Southwest, find a ready-made pile of kindlings in the dry, upstanding nest of the Packrat. In a few minutes, the mound is converted into a glowing pile of coals, with smoke and scorching breath ascending.

Hunters often take advantage of this combustibility to drive the Rats into view for capture. Parks says: "These piles of dry sticks were like so much tinder; so I fired them, the surrounding vegetation being wet and green enough to prevent fire from spreading. Fire was applied at the top, and burned rapidly downward. As they were fired, one at a time, I watched for the fleeing Rats, but saw none. The occupants took to underground passages";[22] prepared for just such an emergency, and so escaped.

---

[20] Texas, p. 112.

[21] Dusky-foot, p. 2.

HOME LOVE

The affection that the Packrat has for his castle, is reflected in these observations by Parks: "On occasion," he says, "I have disturbed Rats [*fuscipes*], and forced them into the trees, where I have thrown sticks at them with the intention of making them move rather than to injure them. If the missile passed close enough, the Rat would move a short distance, and wait for another missile to be thrown. The result almost invariably was that the Rat would travel in a circle that kept it in close touch with the nest. If the nest was destroyed, the Rat could then be driven away immediately, usually to a small refuge nest high up in the trees."[23]

This same observer says further: "The Rats are not satisfied with the underground retreats, for they build small refuge nests high up in the trees in the vicinity of the ground nest. When driven from the safety of the latter, they will take to the trees, and finally seek the shelter of the tree nests. A sudden sharp blow upon the ground nest will frequently scare a Rat into the trees; and on rare occasions, one will go directly to the tree nest. More often, the Rat will remain in the vicinity of the main nest until compelled by force to leave it."[24] Elsewhere he tells of driving the Rats out by burning the nest, and adds that they hid during the fire, but "later came forth and proceeded to rebuild. In a few days, the nests were well under way, and assuming good size. Had a general fire run through the brush, they would have deserted the locality for an unburned site. I have recently (1919-20) witnessed extensive burnings of brushy areas to rid a neighbourhood of Rats; and within a month, many new nests were in process of construction a very short distance from the burned area."[25]

Writing of the White-throated species, under similar fiery visitation, Mearns says: "They were usually very reluctant to leave their habitations, and many were severely singed before they would forsake their domiciles."[26]

---

[22] Santa Cruz, p. 242.

[23] Santa Cruz, pp. 243-44.

[24] As above, p. 246.

[25] As above, p. 242.

[26] Mamm. Mex. Bd., p. 478.

The Mating and Breeding

At Clayton, N. M., I found a female in rut, Jan. 27, 1894.

Speaking of *fuscipes*, English says: "The female mates with a single male, and there is no evidence of polygamy. After mating, the male becomes a hermit, and lives alone in a separate nest which he constructs himself. This nest is small, and usually built in a tree."[27]

The same writer continues: "Wood-rats bring forth their young in the spring, from February to May. The mother is equipped with 4 mammary glands, which are squarely placed, and in the same relative position as on our domestic Cow."[28]

The brood numbers from 2 to 6, with 3 as the usual.

"Seventeen days after birth," says English of *fuscipes*, "the young open their eyes; and weaning takes place at approximately three weeks of age. After weaning, the young, by example of the mother, begin to eat the same green foods."[29]

Though the species is monogamous, the father seems to take no active interest in the young; but the mother, by her devotion, more than makes up for any shortcomings on his part.

Merle F. Bancroft tells us at length of a Packrat that he camped with in the Selkirk Mountains of British Columbia. On July 29th, he found the nest in an old miner's tunnel, 85 feet from the entrance. He says: "It was built up on the floor of the tunnel, and looked very much like a comfortable old hen's nest; but instead of eggs, we found four or five handsome young Rats, gray little fellows with fine, fluffy soft fur, large ears, and bright, black eyes.

"While we were admiring this litter, much to our surprise, the intrepid mother Rat came to the nest; and, in the full glare of the mine lamps, settled herself in a comfortable position. It looked as if the young Rats had just ordered their breakast, and she would not postpone it a minute on our account. But we were mistaken in her intentions; for, after a few minutes, she rose from the nest with a furry burden clinging to her tits. Besides holding on with their teeth, the young Rats had firm hold on the mother Woodrat's bushy tail. Toe-holds, tail-holds, or possibly a combination of both secured them to her. The old Rat made directly for the mine shaft, descending gracefully and proudly, 'with her tail between her legs,' into the inky darkness where there was nothing but the rough rock wall to cling to, in the descent of 50 feet down to the lower tunnel."[30]

---

[27] Dusky-foot, p. 5.

[28] As above, p. 6.

[29] As above.

A great many of the rodents transport their young in this way, at least occasionally; but the Packrat has carried the method to something like perfection—as, indeed, the species has developed everything that relates to transportation, passenger or freight.

A Long Food List

He would not be worthy of his family name if he did not eat all things eatable—fruit or grain, vegetable or animal, man-made or native-grown—that he can secure when hungry. Nevertheless, in this vast acceptability, his emphasis is on nuts, berries, and grain.

As evidence of his food in times of stress, we have some observations by Lee R. Dice, on the species in eastern Oregon. He says: "During late June, 1922, an expedition from the Michigan Museum of Zoology camped for several days in this orchard. We noted that the bark of many of the trees had been gnawed by some small animal, the tooth marks being too small for those of a Porcupine. One night, about midnight, I saw some animal gnawing on the limb of an apple tree over my head, and the next day, I set a steel trap at the base of the tree; during the night, this trap caught an adult female Wood-rat (*Neotoma cinera occidentalis*). There can be no doubt that this species is responsible for the damage done to the trees."[31]

Parks gives many observations to show that in California, certain fungi, especially of the genus *Hysterangium*, are favourite foods of *fuscipes*. Doubtless, *cinerea* will be found possessed of similar tastes. "The Wood-rat," he says, "is the mushroom-hunter par excellence."[32] He found that where the above-named fungus were abundant, Wood-rats likewise were numerous; and says that that fungus "is, in appearance, like a little white puffball with a tough, rubbery gleba, usually of a green colour. Its predominant character is its exceedingly vile odour, when mature. It is almost impossible to carry the plants in a collection, so offensive is this odour. Its habitat is among the leaves, or slightly buried in the ground, where it is easily accessible to the rodents. Where it is to be found, the Rats will pass by all other fungi to get it. I have seen fragments of the white peridium scattered over considerable areas of the forest; and excavations are to be found everywhere. The peridium seems to be rejected for the tough gristly interior portion. It is frequently to be noticed that many young plants are left, the Rats taking only those which have fully matured."[33]

---

[30] Can. Field Nat., May, 1922, p. 88.

[31] Journ. Mamm., Nov., 1925, p. 282.

[32] Santa Cruz, p. 250.

Storage Habit

The Packrat lives in a land of hard winters with deep snow, yet does not hibernate. Therefore, he must store up food in harvest time. That he does so, is attested by many observers.

Thus, Nelson says: "Wood-rats, especially in Northern localities, gather stores of pinyon or other nuts, potatoes, corn, and any other non-perishable food available; to meet the season of storms and scarcity; concealing these supplies in cavities in the nests, either above or below the ground."[34]

One of the strangest detailed testimonies is from A. W. Anthony, who says: "In December, 1916, while engaged in securing data for a report on some mineral lands near Magdalena, N. M., a small mining town 20 miles west of Socorro, I was surprised at the large shipments of pine nuts that were being sent to market from that station. A few miles west of Magdalena, there is a considerable growth of pinyon trees, that might furnish a large harvest of nuts; but, knowing the natural distaste on the part of the Mexican inhabitants for manual labour between meals, I was puzzled to account for the wagon-loads that they were daily bringing to market.

"I was told that 8 carloads had been sent to the eastern dealers, at that date; and as many more were expected before the end of the season.

"Upon inquiring of the Mexicans, as well as the American merchants, I learned that the nuts were all secured from the storehouses of the Wood-rat. Armed with an iron hook, about 3 feet in length, for removing the top of the nest, the Mexican nut-hunter seeks the cactus thickets in the neighbourhood of the pines. The nests and storehouses of the Wood-rat are usually placed in the shelter of the chollo cactus, if any are about, and thus protected, are comparatively safe. The dome-shaped collection of sticks, dead cactus, and in fact everything movable within a hundred feet of the nest, is the retaining wall of a store of nuts, of from a quart to five gallons; the man securing in a few moments what he might pick up from the ground, under the pines, in a day's work. I was told that this store would be renewed within a week; and the same Rat pay rent perhaps as many as five or six times during the fall and winter.

---

[33] Santa Cruz, p. 252.

[34] W. A. N. A., p. 517.

"I think that the storehouses are always separate from the nests; and at times, are at quite a distance from nests that are occupied."[35]

A somewhat conflicting view is taken by Parks—at least as regards *fuscipes* in California. Discussing the quantities of food found in a nest, he says: "No permanent food supply seems to be laid up regularly for winter use, as is the case with the Northern rodents. The climate is such that there is a constant supply of food of some kind available the year round. The conclusion is that, when food is found in the nest, it is there for the feeding of the young."[36]

In one nursery nest, he "counted over 500 acorns, without taking more than half of them."[37] In another, he found "great numbers of madrone berries, which had been cut from the trees in clusters, and taken to the nests as needed."[38]

This different habit discovered in California, may be due to the difference in species; but more likely, to different climatic conditions.

His Museum

The most amazing propensity of the Packrat is the one from which he gets his name—the mania for gathering in one place a collection of bright, curious, unusual, or interesting (but quite uneatable) things—a museum of his own. It is akin to his food-storage and to his nest-building impulses. Yet it has developed into something quite different from either.

There is scarcely any object unusual and small enough, that the Packrat will not add to his museum, especially if it glitter, or, in some way, catch the eye. I have seen nesting mounds made of cactus spines and cow-dung; but the museum exhibit on the top comprised shells, pebbles, pine cones, twigs, sticks, cactus prickles, seed pods, bits of tin and china, old cartridges, broken buckles, rags, leather scraps, feathers, skulls of small animals. I have heard of every movable kind of personal property in the collection, including a bottle of oil, a pair of spectacles, a set of false teeth, a box of matches, and a stick of dynamite.

E. W. Nelson says: "At one cabin in the mountains of New Mexico where I lived one summer, several Mountain Rats made free of the place; and at night, persistently tried to add our shoes to their nest under the floor. An hour or so after retiring, we would hear our shoes scrape slowly across the floor; and in the morning, they would be found stuck toe-down in the broad crack where the floor ended near the wall. In the Wood-rat country, when small articles are missed from camp, it is always worth the trouble to investigate the nearest Rats' nests."[39]

---

[35] Journ. Mamm., May, 1920, pp. 140–41.

[36] Santa Cruz, p. 249.

[37] As above, p. 249.

[38] As above, p. 248.

Merritt Cary found the Pack-rats a veritable nuisance. They were continually stealing his traps. He says: "So commonly was this done, that, on missing a trap, Donald and I would go to the nearest Rat house, where we were almost certain to find it."[40]

"I have a record of a nest," says Parks, "built at a considerable height in a pine tree, that contained the bright inner lid of a lard pail, stolen from the camp table, an old-fashioned perfume bottle with a little mirror on one side, and many musty prunes and crackers. The perfume bottle contained gun oil, and was rescued without the contents having been spilled."[41]

"At the cabin of a friend," he continues, "the food supplies were regularly raided, and the salt and soap seemed to be favourite articles. One spring my friend missed some silk socks and a bright necktie. In the fall, we found both in remnants, together with some soap, in a nest a quarter of a mile away.

"The Rats seemed to develop a streak of mischief with a bit of humour and persistence in it. Every night, the woodbox in the cook shack was a centre of attention. This building being more or less open, the Rats had easy access at night. In the morning, the wood was to be found on the floor, the pieces being laid out in rows, and placed neatly end to end. This was repeated many times."[42]

That the instinct is not lacking in the Eastern Woodrat [*pennsylvanica*] is evidenced by the following from the pen of Earl L. Poole, of Reading, Pa. He says: "On Sept. 2, 1921, I captured two adult specimens of this interesting Rat on top of The Pinnacle, a spur of the Blue Mountains, in northern Berks Co., Pa. . . . Dr. J. J. Shelly of Stony Run and I spent the night on the mountain, after having previously set out several traps.

"From the commotion which these animals made toward midnight, I felt certain that there must be a very large colony about; and in the morning, we were astonished to find that everything that we had left loose, had been carried away by the Rats, even down to our lunch and a pair of spectacles, which had been deposited on a flat rock within a couple of feet of where we slept."[43]

---

[39] W. A. N. A., p. 517.

[40] Quoted by Bailey, Texas, p. 113.

[41] Santa Cruz, p. 242.

[42] As above, p. 248.

[43] Journ. Mamm., May, 1923, p. 125.

As Trader

The second baffling instinct—the one for which he gets his name of "Trade-rat"—is even harder to explain than the foregoing—that is, his habit of exchange. When he pilfers some useless bauble from the ranchman's house, he commonly leaves in its place a product of his own domain. For example, he may carry off the silver spoons, and fill the empty place with toadstools; lug off the kitchen clock, and on its shelf set up a Rabbit's skull; empty the box of chocolates, and fill it up again with cow-chips.

In further detail, Parks says: "They have a fondness for dried prunes, crackers, bits of glass, bright metal, and sometimes, pieces of brightly coloured cloth; and will carry such things to the nests for storage. In exchange, they leave a chip, a small stone, or anything that may happen to be handy: and such things were frequently left in place of my bread and potatoes."[44]

I knew of an old-timer who went in haste to the drawer where he kept his revolver cartridges. He grabbed a handful, and then found he had nothing but Elk pellets. The Trade-rats had taken the ammunition, and left these in its place.

One of the best gold-mines in Saline County, Ariz., is said to have been discovered in the following way. A Packrat stole a number of trifles from the miner's cabin; but, in their place, left some nuggets and valuable bits of gold quartz. The miner watched the Rat, located the vein, and made his fortune.

It is not necessary to postulate a theory of commercial honesty on the part of the Rat or even a sense of humour, when we seek for explanation of this give-and-take. So far as I can analyse it, the Rat, impelled by the museum avarice, carries off a spoon to his own particular cabinet. He drops the spoon. The mania to carry is still on him; so he seizes any of the near-by objects—cones, cow-dung, or pebble—and carries it back on the return trip. Here the superior allurement of the spoons causes him to drop the cow-chip, and take another spoon. In this way, apparently, the trade is effected.

Who Will Tell Us?

It would shed valuable light if some trained naturalist would, by experiments, answer such questions as these: Is the museum instinct an outcome of nest-building, of food habit, or what? Is the museum ever remote from the nest? Is the instinct found in both sexes? (By all the rules, it should be strongest in the old males.) Do two Rats ever combine their efforts in one museum? Do individuals specialize on certain lines of curios? Do they show colour preferences? Is the creature ever seen gloating over his collection, or arranging it, or spreading it out in the sun? Do they steal from each other's museums? If so, do they leave an exchange value? Have they any social life? If so, does the museum figure in it?

---

[44] Santa Cruz, p. 242.

There cannot be the least doubt that, in its last analysis, the Packrat's impulse to gather treasures, is precisely that of any other curio collector—the pleasure he gets in seeing, handling, and owning strange and attractive things. We must admit that, however crude, it is an æsthetic instinct, like that of the Australian bower-bird, or of the human collector, who devote their best energies to amassing and arranging beautiful and curious objects at a special and prepared place, a place that has no relation to their ordinary functions of life.

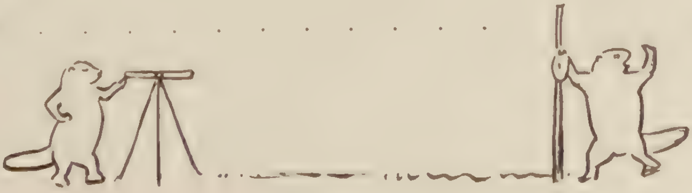
REFERENCES

1905—Biological Survey of Texas, by Vernon Bailey, N. A. F., 25, pp. 107–114, 2 maps.
1907—Revision of the Wood-rats of the Genus Neotoma, by Edward A. Goldman, N. A. F., 31; 124 pp.; many ills.
1907—Mammals of the Mexican Boundary, by Dr. E. A. Mearns, Smith. Inst. Bull. 56, pp. 467–492.
1918—Wild Animals of North America, by Dr. E. W. Nelson, pp. 516–17.
1922—The Genus Neotoma in the Santa Cruz Mountains, by Harold E. Parks, *Journ. Mamm.*, Nov., pp. 241–53; full biographical notes.
1923—The Dusky-footed Woodrat, by Pennoyer F. English, *Journ. Mamm.*, Feb., pp. 1–10; 4 plates.

LIFE LXXXVII—MOUNTAIN BEAVER

PAGE
Names 526
Description: Size, Weight, Colour, Musk, Tear Fluid, Testes, Whiskers 527
Races 527
History 528
Range and Haunts 529
Numbers 531
Ou-ka-la Colonies 531
Burrows and Tunnels 533
Water Control 535
Drink 536
Food 536
Feeding Habits 537
Haymaking 538
Storeroom Door 540
Health Department 540
Nest 541
Mating and Young 541
Traps and Troubles 542
Damage and Trapping 543
Gifts and Gait 544
Non-aquatic 544
Climbs Trees 545
A Night Bird 545
No Winter Sleeper 547
His Way of Life 548
Unsociable and Gloomy 550
The Voice of the Silent One 551
The Gnomes' Revelry 552
The Forest Gnome 553

References 554



Mountain Beaver, Sewellel, Blue Muskrat, Mountain Boomer, Ground Beaver, Underground Beaver, Muskrat Beaver, Showt'l, Kick-willy, Giant Mole, Ou-ka-la, Haplodon, Aplodon, or Chehalis

Aplodontia rufa (Rafinesque)

(Gr. *aploos*, simple; *odous*, tooth, from the apparently simple structure of the molars; L. *rufa*, reddish)

Anisonyx (?) *rufa* Rafinesque, 1817, Amer. Monthly Mag., II, p. 45, Nov.
Aplodontia rufa Merriam, 1886, Ann. N. Y. Acad. Sci., III, p. 316, May.

Type Locality—Near Columbia River, Ore., probably in the Cascade Mts. Taylor regards as typical, specimens from the western slope of Mt. Hood.

French, *L'Aplodontia brune.*
Yakima, *Squallah* (Cooper).
Chinook. "The Chinook name for the animal itself is *O-gwool-lal*. *She-wal-lal* (Sewellel, corrupt) is their name for the robe made of its skins." (J. G. Cooper.) *Showhurll* (Suckley, p. 100). *Showt'l* is another form of the same; but W. P. Taylor gives a dozen by which the local and small groups of Indians know this strange creature.

The name *Mountain Beaver* has some warrant in the creature's relationships, as we shall see, and is further justified by the largest usage.

The genus *Aplodontia* (Richardson, 1829) comprises rodents the size of a small Woodchuck or a Rabbit, with short legs, thick bodies, short ears of almost human shape, and a tail so short that it does not stick out beyond the fur. The genus is characterized by having 5 toes on each foot; but the inmost toe on the front foot, that is, the thumb, is a mere stump which, however, acts as a pusher. The other fingers work against it; and it can take a good grip of food that the creature is eating, of stones that it would dig out, or the limbs of trees when it climbs. The group has long, digging claws, 6 mammæ, and teeth as follows:

$$\text{Inc. } \frac{1-1}{1-1};\ \text{prem. } \frac{2-2}{1-1};\ \text{mol. } \frac{3-3}{3-3} = 22$$

Thus, the teeth are exactly as in *Marmota* and others of the Squirrel Family, to which it is distantly related; having affinities, indeed, with both Marmot and Beaver.

In addition to the generic characters, the Mountain Beaver has the following:

Size. Length, 13⅛ in. (336 mm.); tail, about ½ in. (12 mm.); hind foot, 2¼ in. (56 mm.).

Weight. 4 lbs.[1]

Colour. All above, in all seasons, light ochraceous-buff, sometimes shaded into light buff on the fore parts; sprinkled over everywhere with blackish hairs; all below, grayish, with a faint wash of brown; a white spot at the base of the ear.

Sexes alike, but adult females often have prominent dark spots about the mammæ. The young are like the adults, or a little darker.

When seen close at hand, the Mountain Beaver looks like a dark Rabbit without ears, or a small blackish Woodchuck without a tail.

In some of its habits, as well as appearance, this animal greatly resembles a large Pocket-gopher (*Thomomys*). In each we see the result of perfect adaptation of the creature to underground life, where it must dig a new tunnel each time it would explore in a new direction.

Musk. The freshly killed animal gives off a penetrating musky odour that reminds one of the Muskrat. This musk is so strong that it persists on skins that are several months old.

Tear Fluid. The tear fluid of the eyes is remarkably thick and sticky, and is opaquely whitish; it looks like a white film across the eye. Doubtless, this fluid is specialized to be more effective against the loose earth of its underground home.

Testes. According to C. A. Hubbard,[2] the testes are normally in the abdominal cavity; but, in the mating season, are lowered outside or withdrawn at will.

Whiskers. The remarkably developed whisker bristles are doubtless significant, but no one yet has written their story.

RACES

Following Walter P. Taylor's admirable revision of the genus, these races are recognized:

rufa Rafinesque, the typical form. T. l., Marmot, Clackamas Co., Ore

---

[1] Merriam, New Species, p. 314.

[2] Some data, p. 17.

californica Peters, like *rufa*, but grayer, and with different skull. T. l., Blue Canyon, Sierra Nevada.

rainieri Merriam, like *rufa*, but grayer, with less brown beneath, and different cranial characters. T. l., Mt. Rainier, Wash.

olympica Merriam, like *rufa* externally, but different in skull characters. T. l., Quinault Lake, Chehalis Co., Wash.

columbiana Taylor, like *olympica*, but larger. T. l., Hope, B. C.

pacifica Merriam, small and very dark. T. l., Newport, Yaquina Bay, Ore.

phaea Merriam, a small brown race; smallest of the races, and palest of the coast forms. T. l., Pt. Reyes, Marin Co., Calif.

nigra Taylor, very dark, shiny black, faintly peppered above. T. l., Pt. Arena, Mendocino Co., Calif.

humboldtiana Taylor, like *pacifica*, but larger and paler. T. l., Carlotta, Humboldt Co., Calif.

It will be noted that these are in two groups—first, a group of large gray forms in the high mountains; and second, of small dark forms along the Coast Range.

HISTORY

Like the Mule-deer, the White Goat, and several other species, the Mountain Beaver was introduced to the world of letters by Lewis and Clark.

In Dec., 1805, these leaders of the famous expedition reached the West Coast, and established winter quarters at Fort Clatsop (now Astoria, Wash.). On Friday, 13 Dec., notwithstanding its combination of ill omens, this lucky entry was made in Clark's record:

"The *Clatsops* leave us to-day after a breakfast of Elk, which they appeared to be very fond of. Before they left us, they Sold me two robes of the skins of a Small animal about the size of a Cat, and to Captain Lewis 2 Cat or Loucirva skins, for the purpose of makeing a Coat."[3]

The Indians, when questioned about the two strange skins, said they were "*She-wal-lal*," that is, used to make a "*robe*." But knowledge of each other's language was rudimentary; and Clark, in perfect good faith, wrote "Sewellel," as the Indian name of the animal. But this was Friday, the 13th. The name was most unfortunate. It was not descriptive; it was not easy to say or remember; it was not composed of familiar elements; the accent was wrongly placed; in short, it was not English, and couldn't be Englished. Therefore, it is disappearing; even now it has nothing but a book existence.

---

[3] Exped., Paul Allen edition, Phila., 1814, II, pp. 176–77.

However, this was the first time of record when a white-man set eyes on the skin of this curious creature. This was its introduction to history, and led ultimately to systematic consideration.

In 1817, the erratic, enthusiastic, and voluminous Rafinesque plunged in on the strength of the Lewis and Clark account, and named the creature *Anisonyx rufa*. Here is the whole of his account:

"*Anisonyx* (?) *rufa* Raf. Fur long, silky, entirely reddish brown, ears short, pointed with short hair.—Obs. This animal called Sewellel by Capt. Lewis and Clark, is of a doubtful genus, since they only saw the fur of it; it burrows, and runs on trees like the Ground-squirrels; length, 18 inches, found in neighbourhood of the Columbia River."[4]

The generic name *Anisonyx* was rejected because it was apparently based on the Ground-squirrel of which the earliest name is *Citellus*.

In 1829, Dr. John Richardson secured a skin—probably the first known to a scientific naturalist—through the fur-traders of the Hudson's Bay Co., and established the genus *Aplodontia*, of which it is the type and sole member.

In 1860, George Suckley offered a few notes on its habits.[5]

In 1866, J. K. Lord contributed a brief life-history.[6] J. M. Murphy (1876), F. S. Matteson (1877), S. K. Lum (1878), A. Brooks (1899), and J. Muir (1909), all helped our knowledge. But the really illuminating accounts were H. E. Anthony's "Habits of Aplodontia" (1916); W. P. Taylor's "Revision" (1918); and latest, the admirable monograph by Charles L. Camp (1918), which, with Anthony's paper, is the basis of the present life-history.

Range and Haunts

Map II (p. 85) shows the main outlines of its range, doubtless larger and less broken than here implied. It is a creature of dense forests, of heavy rainfall, and temperate climate; is absolutely confined to our West Coast; and has no generic brethren, so far as known, living anywhere else in the world. It has the smallest range of any species treated in this work, with the exception of the Round-tailed Muskrat.

Within the broad outline of the great range strung north and south on the map, among the noblest forests of America, are the chosen haunts of this odd creature. Its ideal homeland is pretty well known, and partly understood. The animal is happy only in deep alluvial soil where it can burrow freely; it must be near running water—indeed, it prefers a soil oozing with water—is it not a Muskrat-Beaver? It must be in a place that abounds in plant growth—root, shoot, and overlimbs. Damp, dense, heavily forested, sunless woods, along low, slow, muck-banked streams, are much to its taste. It is like a Muskrat that has taken to the haunts of the Beaver, and adopted the habits of a Mole.

---

[4] Amer. Monthly Mag. & Crit. Rev., 2, p. 45.

[5] U. S. Pac. R. R., p. 100.

[6] Naturalist, Vancouver Id., I, Chap. 13.

Although boggy slopes and the banks of streams are the favourite situations, tunnellings in dry wooded and brushy places at a distance from water are sometimes inhabited in the wet season, and abandoned in the dry—an arrangement that most of us would reverse. If the food supply continue, such burrows may be used the year round.

Along the coast of California, the Mountain Beavers invariably choose for their colony a spot within dense thickets of ferns, thimbleberry, and other low plants in wet, or at least damp soil. So well concealed beneath tangled shrubbery are the unplugged burrows, that commonly the presence of the animals is unsuspected even by the settlers on the same land.

In the interior mountains, the larger or upland races seem to select a slightly different home range. They are sometimes in flats, but much more often along canyons and mountain slopes, among willow, alder, aspen, or other thickets, or even in the heavy coniferous forest.

Townsend says that in northern California, "these burrows were in a wild gorge, deep and narrow, down which the little river dashed with roar and foam. In certain places, where for a short distance, moist, clayey banks took the place of the interminable fallen trunks and boulders, were numerous holes, somewhat resembling those made by Muskrats."[7]

Lum notes that the species of Mountain Beaver along the western base of the Cascade Mountains "usually selects the open glades of the forest, thickly grown up with fern and sallal" for its burrows.[8]

In California, at the southern part of its range, Aplodontia usually prefers a shady, north slope for its burrows; but Brooks states that in British Columbia, the extreme northern range of the genus, this animal prefers a locality "where there is a good thick growth of vegetation on the mountain slopes, especially on those with a south exposure."[9]

"*Aplodontia rufa californica* of the Sierra Nevada, in California, has been found in a variety of situations, at elevations all the way from 5,500 to 10,000 feet."[10]

---

[7] Field Notes, p. 175.

[8] Sewellel, p. 10.

[9] Recreation, p. 258.

[10] Camp, Excavations, p. 522,

Finally, Frank Stephens says of the colony he found at Cuddeback, Humboldt Co., Calif., "My previous idea of a burrowing place for Aplodontia is wet or springy land. This is far from that. It is a very steep, south-facing slope almost at the top of a point on a high ridge, and is as dry a place as well could be found. The location is in an open place in a thick forest of redwood, spruce, and fir. It has been burned over three years ago, and there is very little underbrush."[11] This is so variant from the established custom of the species, that it must be listed as an abnormality.

NUMBERS

The only positive note I find on its numbers is the following: "Specimens were collected in the vicinity of Tillamook, Oregon," says Anthony, "where the animals were found in abundance,"[12] which is not positive at all, but comparative. For the creature may be numerous, if we compare it with Grizzly-bears, and very rare indeed if compared with Meadowmice.

It seems to be found in considerable colonies, when found at all; and yet the trappers say it is easy to clear out these colonies. The observations of Camp, given later, show that in a flourishing colony of 100 x 500 feet, 11 individuals were taken, and seemed to be the total population,—whether parents and young, does not appear. Extensive tracts in the Cascades are honeycombed with its burrows, as fully shown; and yet we do not know how many to the square mile should be considered abundant.

Its skin is not of commercial value, so that we cannot tell how many are marketed each year. Thus, we have no positive data; but it seems clear that it is nowhere abundant, in the sense that Rabbits and Marmots are in places; and we know its range to be very small.

OU-KA-LA COLONIES

If the creature is not sociable, why should it live in colonies? We have elsewhere noted the distinction between "sociable" and "gregarious." It seems that this underground Beaver is slightly gregarious in its habits. Thus Nelson writes:

"Veritable colonies inhabit certain areas, and the ground is honeycombed with burrows 6 to 8 inches in diameter, and covered with a network of surface trails. The irregular, branching tunnels are sometimes two or three hundred feet in length; and have, at frequent intervals, side passages through which the earth, mined in extending the burrow, may be ejected in small dumps. The tunnels appear, in a large measure, built for the safety of the owner in travelling; since they repeatedly come to the surface at the end of a log, where an open, neatly kept trail extends under its shelter the entire length, the tunnel being resumed at the far end of the log.

---

[11] Ms. 1910, quoted by Camp, Excavations, p. 522.

[12] Habits, p. 53.

"All surface runways connecting tunnel entrances, or leading through the thick surface vegetation, are well kept, and free of all obstructions. The ground in these haunts is commonly so saturated with water that the tunnels form drainage channels down which run little streams."[13]

Anthony, however, with larger opportunities, writes: "The 'colonies' of this animal . . . were found most frequently where vegetation was rankest, and where moist, loose soil made digging easiest. When such a place is encountered, the large holes and piles of earth thrown out from the burrows, are generally numerous, and indicate the presence of several individuals, as well as a marked degree of activity of the individual.

"While it has been asserted that *Aplodontia* is a gregarious animal, and lives in colonies of several individuals, it is, however, more than probable that this number is not very great. A series of runways is inhabited by a single family; and there is no evidence that this animal is as social in its habits as, for example, *Cynomys* or *Microtus*. One might be led to suppose many individuals were present because of the amount of earth thrown out, and the numerous runways; but this is easily accounted for by the activity of the Showt'l.

"Traps set in the runways were almost always successful the first night —one and possibly two animals being caught. Thereafter, traps set in the same immediate vicinity yielded nothing for several days at a stretch, probably until some neighbours wandered over from near-by runways. This lack of success in trapping after the first 2 or 3 animals were caught, was not due to caution on the part of the animal, for *Aplodontia* exhibits no inherent cunning, and is easily caught in exposed traps. Furthermore, no fresh dirt was thrown out after the first animals were caught, nor were any of the cut leaves and green twigs, so commonly lying about the burrows, to be seen. All the evidence pointed unmistakably to a depletion of the colony; after 2 or 3 had been caught, the burrows had a lifeless appearance, and débris that had fallen into the runways was undisturbed. By shifting the traps about, it was ascertained that the area dominated by these few individuals was rather extensive; for not until traps had been shifted some distance, could another set of animals be taken."[14]

Another interesting observation by the same naturalist tends to prove that an abundant food supply, rather than love of good company, is the cause of many Ground Beavers assembling in a given place.

---

[13] W. A. N. A., p. 532.

[14] Habits, p. 54.

"Much the largest and most flourishing colony," he says, "was found in the orchard of a deserted farm. Here under 'evergreen' blackberry bushes, large quantities of earth were thrown out every night, and great activity was evident. It is not improbable that the tall, rank grass, and such low fleshy-leaved plants as the dandelion, were the important food items here; for cut grass stems were seen about the burrows, and the absence of any other suitable food went to support this supposition."[15]

Burrows and Tunnels

Wherever the Mountain Beaver establishes itself, it digs a complicated network of tunnels, from a few inches to two feet below the surface of the ground. These tunnels are extensive in proportion to the number of the animals in the colony (Plate LXIX, p. 546), which probably means that each pair has a main burrow which ramifies and joins on to the home run of the next digger.

Each burrow system has many openings to the surface. As with most tunnelling animals, some of these openings are for entries, some for dumps, and some with small concealed openings, for ventilators. Furthermore, it seems that some of them are for drains.

C. A. Hubbard describes burrows of two types—the home or individual burrow, and the communal burrow.[16]

The home burrow is short and simple. It is situated in a bank whenever possible. It contains the nest that is the family home. It is private property, and is held jealously against all intruders.

The communal burrow is very large, long, and complex. Its interior shows that it has been used by the colony for years. "The sides are worn smooth," he says, "and are packed tightly by the brushing past of generations of the animals. . . . [The] floor is packed so hard by the patting of myriads of feet, that it can be taken up as if it were asphalt.

"These communal ways connect each individual system. They lead to water, to favourite feeding grounds, and form a means of communication during the breeding season."[17] They are, indeed, the streets of the town on to which open the hallways of the home burrows.

How large are these towns? We may form some idea from the following:

---

[15] Habits, p. 58.

[16] Some data, p. 14.

[17] As above, p. 15.

Camp says: "Near Point Reyes, in the gulches 5 miles west of Inverness, Marin County, Calif., trapping was carried on in 1913 in 2 colonies of *Aplodontia*. . . . The burrows extended along the side of a low, north-facing bluff, among bare hills for 2 miles or more.

"One section of this colony, in a rectangular area about 500 x 100 feet, contained at least 100 burrow entrances. Here 169 'trap-nights' (one trap out one night equals one trap-night) in 36 burrow entrances, produced 11 specimens. No individuals were secured in the last 46 trap-nights—an indication, perhaps, that the catch approximated the total population of that part of the colony: 92 trap-nights in another limited part of the above colony, produced 6 specimens."[18]

Similar burrows were examined at Point Arena, Mendocino Co., Calif. The form of this region "lives on north-facing gulch sides in a small area (about 24 square miles) along the central Mendocino County coast. The colonies now known, extend from the town of Point Arena to Alder Creek, 7½ miles north. In the case of the race *phaea*, colonies occur in a part of the Point Reyes Peninsula and country adjacent, in Marin County, Calif., an area of not more than 110 square miles in all."[19]

Such complex and extensive subterranean villages remind one of the Catacombs of Rome during times of persecution, or of the residential salt-mines of Galicia to-day.

These far-reaching underworlds of the Mountain Beaver, however, are evidence of unusually congenial conditions. It seems that localities of skimpy food supply result in a much sparser population.

"In the Yosemite National Park," says Camp, "extensive thickets of the preferred food plants are scarce; and here the Mountain Beaver must, as a rule, be content with limited tunnel systems through the narrow willow-fringes along the streams.

"At Chinquapin, 6,200 feet altitude, in the Park, a tunnel [Plate LXIX, Fig. 3] of *Aplodontia rufa californica* was excavated for a distance of 12 yards along the steep bank of a stream, without the discovery of a single side branch of importance. Only 2 individuals, male and female, were captured in this tunnel. The burrows in the colony at Chinquapin were far scattered along-stream, owing to the narrowness of the area available to the animals. At many other localities in the Park, similar conditions prevailed. Small colonies with more complicated systems of runways are sometimes established where conditions will allow, as, for example, in willow thickets bordering meadows and, high up in the mountains, in Labrador tea and willows along creeks and about springs.

---

[18] Excavations, p. 520.

[19] As above, pp. 521–22.

. . . .

"The burrows of *Aplodontia rufa rufa* of the Trinity and Siskiyou mountains, to judge from the descriptions given by Kellogg (1916, pp. 369-72) and Alexander (Ms., 1911), appear to be similar to the more simple type of tunnel system of *A. r. californica*. Even in one exceptional case where the ground was found to be 'literally honeycombed' by burrows and runways, a 'main tunnel' could be distinguished. As with *californica*, never more than one pair of animals was secured from a single set of runways."[20]

Like the Pocket-gophers, the Mountain Beaver is often active under the snow; and the soft earth is pushed up into the snow tunnel, filling it for some distance, so that when the snow melts away, the curious earth plug, the cast of the snow tunnel, is left exactly as noted in the Pocket-gopher. (See Plate XLVII, p. 411).

Water Control

One of the most Beaver-like and interesting exploits of this animal is the management of underground streams. Whether it is done for drainage, or for a drinking supply in a safe place, or by accident, it seems clear that the Showt'l commonly controls the water supply that belongs to his home range. He has the true instinct of the Western homesteader; the moment he has selected his location, he sets about coralling and controlling the water.

Lum says of those burrows he examined on the Cascade Mountains, "In many places, I found water coursing its way through the passages."[21]

Stephens says: "In a few cases, spring brooks had broken into the upper entrance, and ran in the burrows instead of in their natural channels. In one case, a brook was diverted from its own channel to . . . one several yards away."[22]

"Arrangements are always made for the proper drainage of the burrows," says Camp, "and in wet hillsides water often runs continuously from the lower tunnels. In some places, the courses of streams are diverted, though perhaps accidentally."[23]

---

[20] Excavations, pp. 524-25.

[21] Sewellel, p. 10.

[22] Calif. Mamm., 1906, p. 94.

[23] Excavations, p. 532.

"In almost every colony, tunnels were found containing running water. At one place, the entire flow of a small stream was taken care of for some distance below ground."[24]

John Muir seems to have been singularly fortunate in discovering a new irrigation ditch at the triumphant moment when first the water was turned on. He relates that, in the Yosemite Park, the Mountain Beaver "digs canals, and controls the flow of small streams under the sod"; "and it is startling," he says, "when one is camped on the edge of a sloping meadow near the homes of these industrious mountaineers, to be awakened in the still night by the sound of water rushing and gurgling under one's head in a newly formed canal."[25]

DRINK

Although not aquatic, in the sense that holds with Beaver and Muskrat, the Mountain Beaver is not happy away from the water. It drinks much and often. Brooks says: "Where numerous, its burrows extend in all directions underground, one or two well-travelled highways always leading to the nearest water."[26] And Anthony adds that his captive drank large amounts of water when it was given him, not lapping daintily like a Cat, but dipping his nose into the water to drink copiously as though he enjoyed it.[27]

FOOD

With a vast number of careful observations before me, I hesitate to enumerate the food plants of this animal. It would be little more than a barren, botanical list, covering two pages, and including really every green, succulent, and semi-succulent plant, shrub and bark that is found in the rich, wet grounds where gather the Mountain Beavers to burrow and seek their daily provender. The only plants native to their range and not on that list, are probably the actually poisonous, or wholly woody kinds.

They have their favourites, of course. On the Coast Range, they "are predominantly fern- and root-eaters."[28]

In the north, its "favourite food plant is the 'Scotch Cap' *Rubus nutkanus.*"[29]

---

[24] Excavations, p. 525.

[25] Our National Parks, 1909, p. 201.

[26] Recreation, p. 258.

[27] Habits, p. 56.

[28] Camp, Excavations, p. 525.

[29] Brooks, Recreation, pp. 258–59.

In Oregon, according to Anthony, its choice is thimbleberry, elkbrake and sword-fern.[30]

In captivity, it shows its adaptability by eating celery, carrots, turnips, potatoes, cabbage, lettuce, apples, and other fruit.[31] Why not? I should like to ask, if in its native village, it is taught to look on coarse-grained elkbrake and fibrous sword-fern as sweet and luscious dainties.

"Since its country has become increasingly occupied by farmers, it has developed a fondness for cultivated crops, that, in many places, is rendering it a pest. It appears to have a special taste for cabbage, potato, and onion tops, and other garden produce."[32]

FEEDING HABITS

The Mountain Beaver, according to Camp, "is rarely seen in the daytime, but comes forth early in the evening in search of food, and doubtless remains active throughout the night. [B. J.] Bretherton[33] mentions that he has trapped a large number without ever having seen one abroad in daylight. Our own observations, as well as those of others, confirm him. An individual . . . that the author kept captive, built itself a nest where it remained passive in a sitting posture throughout the day."[34]

"The manner of feeding has been observed in the captive animal, and partly determined from the evidence of cuttings. The rodent usually sits back upon its short tail, with the back curved, the hind feet extending out in front, soles forward, and the fore paws grasping the stem, root or leaf. The short first finger is used like a human thumb, and the large callosities on the palms aid in holding an object so firmly that it can be retained easily in one hand. Stephens (1906, p. 95) says that the hind feet as well as the fore feet are used in grasping. Plants are harvested in sections from 2 to 6 inches in length, so that they can be dragged into the burrows. Tough, woody twigs and stems are chewed through from one side only, not in the manner in which Beavers attack large trees. If the plant is a soft annual, the whole stem is rapidly nibbled; if a perennial, the bark is chewed off in the manner of a Beaver or Porcupine, and the wood discarded."[35]

Anthony, describing the food habits of one which he held captive, says: "So rapidly did he become tame that, by nightfall of the first day, he took young fern shoots from my hand, and ate them while seated upon the window sill of my room, completely oblivious of my presence. His appetite was good, and he ate a number of fern tips, generally selecting the youngest and softest from the handful offered him. The elk-brake, *Pteris aquilina*, that seems to be one of his main articles of diet, has many branching stems that bear the green foliage. The Showt'l clipped off an inch or two of the terminal stems, a single snip of the sharp incisors generally severing the small stem. Then holding this stem in his fore paws, the animal passed the tender fronds back between the molars; and with a rather hurried crunching, munched them down, mastication, though rapid, seeming to be quite thorough and audible as well. The lateral stems were clipped off close to the main stem, and after the greenest of the terminal stems had been eaten, the animal, after sniffing over the rest of that particular fern, passed on to a fresh one, some preference being given to the more succulent portions. If a stem that was fairly hard and brown was trimmed off, after the fronds had been devoured, it was discarded."[36]

---

[30] Habits, p. 57.

[31] Camp, Excavations, p. 527.

[32] Nelson, W. A. N. A., p. 532.

[33] Some Oregon Mammals, Oregon Nat., II, 1895, p. 124.

[34] Excavations, p. 528.

[35] As above, pp. 529–30.

"This rodent is slow and cumbersome in gait, and seldom ventures far from its burrow. Tunnels are dug directly into suitable clumps of vegetation where the animals wish to forage, and from the burrow entrances issue short trails or runways along which the animal transports cut stems and leaves to the mouths of its burrow system. Occasional sections of cut material are dropped along these pathways, thus distinguishing them from the runways made by Rabbits and Ground-squirrels. Remains of fresh leaves and twigs pulled just within the burrow entrances, lead one to believe that the timid Mountain Beaver does much of its feeding in the comparative security of its burrow."[37]

Haymaking

One of the most picturesque habits ascribed to this somewhat unpicturesque animal, is haymaking. Every recent observer has noted it, and offered some enlightening comments which may be summed up thus:

"Gibbs (in Suckley, 1860, p. 100) was the first to note a peculiar haymaking habit among the Mountain Beavers he found living at the top of Yakima Pass, Washington. 'Near their abodes,' he says, 'were small bundles of some herb or plant cut with nicety, and laid out on logs to dry or wilt'; and Lyon ([Mamm. Mt. Rainier] 1907, p. 91) and Bretherton (1895, p. 124) confirm this. Townsend (1887, pp. 174–175) thought he recognized the haymaking instinct among the *Aplodontia* he observed on the North Fork of the Feather River in California. Elliot ([Mamm. Olympic Mts.] 1899, p. 252) makes particular notice of the haymaking habit, and adds that the cured stems of the lily, which he saw *Aplodontia rufa olympica* using, may be employed either for food or as bedding in the nests.

---

[36] Habits, p. 56.

[37] Excavations, pp. 528–29.

"Stephens ([Calif. Mamm.], 1906, p. 95) writes: 'I saw bunches of plants laid up on low bushes to dry, commonly over entrances to burrows, most of these not being much dried, as if they had carried them in as soon as they were well wilted'—this in regard to *Aplodontia rufa californica*, on the headwaters of the Carson River in Alpine Co., Calif. Miss Kellogg ([Mamm. & Birds, Calif.] 1916, p. 372) speaks of the habit in question as occurring among the colonies of *Aplodontia rufa rufa* discovered on the South Fork of the Salmon River in Siskiyou Co., Calif. She says: 'We found the Mountain Beavers making what we call hay—large bunches of green plants of various kinds cut up and spread out as if to dry and to be used later.'"[38]

"The Mountain Beaver has the interesting habit of gathering stores of green plant food, much like that of the Cony on the mountain tops, but appears to be more methodical in its ways, gathering the stems of such plants as grasses, ferns, and lupins, as well as twigs of various bushes, and carrying them in bundles as large as can be held in the mouth, the butts of the stems neatly laid together. These little bundles of 'hay' are placed side by side about the entrances of the burrows, with the butts all parallel on sticks or other support, to keep them as clear as possible from the ground. They are left thus for a day or more to cure before being carried into the subterranean storerooms."[39]

More than 30 species of native plants have been found among the hay piles at the mouths of burrows.[40]

Now to smear this interesting picture, comes Chas. L. Camp, who, summing up these haymaking pursuits, says:

"From observations of the nests and of feeding habits, my own conclusion is that the animal does not eat dried food, but uses its hay for nest-building material."[41]

The answer is: This may be true in summer, when succulent food abounds, and when Camp observed it; but it is well known that the nesting instinct of rodents is close kin to the food-storage instinct. Indeed, they grade into each other, and it is morally certain that the Mountain Beaver sleeps on his supplies; that the hay cured and stored in summer is used for food when winter with deep snow shuts off a large proportion of the forage. The Mountain Beaver, like the Calling Hare and many of the Ground-squirrels, will find it much pleasanter to stay at home, and eat dried breakfast foods, rather than venture out into a cold, icy world to seek for forage, most of which at this time, is far inferior to his sun-dried hay.

---

[38] Excavations, p. 529.

[39] Nelson, W. A. N. A., p. 533.

[40] As above, p. 532.

[41] Excavations, p. 529.

Storeroom Door

"A singular habit has been noticed in connection with the storage of food. In a burrow excavated at Point Reyes [Plate LXIX, fig. 2] the entrances of two of the food storehouses were found plugged with large pellets of earth, evidently manufactured by the animal for this especial purpose. Those earthen balls were 1 to 2 inches in diameter, and very hard and dry, evidently from having been handled a good deal. It is curious that the outer burrow entrances are not similarly plugged."[42]

Health Department

"The fæces are black, about the shape of those of a Pocket-gopher but larger (in *Aplodontia rufa phaea*, measuring 6 to 7 by 15 to 20 millimetres); the urine is yellow and cloudy. Fæces are rarely seen about the burrows; they are probably deposited in some particular place underground, but I have never succeeded in discovering any in the burrow systems excavated."[43]

"Like burrowing animals generally, the Mountain Beaver is cleanly in its housekeeping; and offal, loose dirt, and débris of all kinds are pushed out by the fore feet and head to the dumps at the less used openings."[44]

Unless the Ground Beaver is different from all other highly specialized miners, he will be found to have somewhere—yes, many wheres—in his tunnels, little dry earth-closets in which proper care is taken of the digestive by-product.

"Arrangements are always made for the proper drainage of the burrows; and in wet hillsides water often runs continuously from the lower tunnels. . . . The Mountain Beaver is not aquatic in any true sense, but is often caught in traps set in the water running through the burrows. The animal is said to dip its fore feet in water and to wash its head."[45]

---

[42] Camp, Excavations. Compare *Thomomys*, Life LXXXIII, p. 407, ff.

[43] As above, p. 531.

[44] Nelson, W. A. N. A., p. 532.

[45] Camp, as above, p. 532.

NEST

For long, nothing was known of the breeding habits of this elusive earth-gnome in the darkest forests. The recent careful observations by Camp and Scheffer, however, have shed a good deal of light.

At one point of the tunnel which Camp opened at Point Reyes in 1913, he discovered a nest "half filling a globular chamber about a foot in diameter [Plate LXIX, Fig. 2]. The nest was constructed for the most part of dry sword-fern 'leaves' stripped from the frond stem. It also contained a few large dry leaves of the cow parsnip, a plant nearly everywhere found in the vicinity of the burrows. Some dirt was mixed with the nest, and the whole had been trampled down into a firm mass, flat on top. Adjoining the nest chamber in the excavation mentioned, and opening into it, was a low square 'room' 20 inches in diameter, the floor and sides of which showed signs of continued use by the inhabitants. Pockets near by contained stored roots, stems and leaves carefully blocked in by artificial earth pellets."[46]

"Nest chambers discovered by T. H. Scheffer in the Olympic Mountains were located in tunnels 2 feet underground. They were oval in form, and one measured 18 inches in horizontal diameter and 17 in height. Here 3 storage chambers opened directly from the nest chamber, one of which contained 2 quarts or more of sections of fern roots, which had been kept so long they were spoiled; and another was partly filled with freshly cut leaves of nettles and twigs of cedar and fir. At the far end, an opening dropped 6 inches into a small drainage basin partly filled with water, out of which led 2 passages. The roofs of the chambers were lined with a thin layer of clay, which appeared to have been packed in place by the owner."[47]

MATING AND YOUNG

Almost nothing is known about the mating and breeding habits of this furtive creature. Trappers generally testify that a pair are found in each labyrinth, and when these are caught, all signs of occupancy in that place cease for a time.

On Mt. Shasta, Osgood concluded, after much observation, that "only one individual or, at most, a pair, lived in one place; though several may be distributed among the branches of a stream."[48]

C. A. Hubbard's observations on the breeding may be thus summarized: The mating season is February and March. The species may be promiscuous, but there is some evidence to show that they pair. Gestation probably lasts 6 or 8 weeks.

---

[46] Camp, Excavations, p. 521.

[47] Nelson, W. A. N. A., p. 532.

[48] Merriam, Shasta, p. 93.

In 1918, the first pregnant female was taken Feb. 26th; she carried two small embryos, about the size of buckshot.

The young are born about April 15th. They are usually 2, but, in some cases, 3 or 4 in number. The male does not help in caring for them.[49]

Scheffer says of the chamber already described: "In the upper and drier part of the nest, which was made of dried fronds of ferns, grasses, and small twigs, were found 3 young less than a week old, with coats of fine fur, but with eyes still closed."[50]

During May, many females were taken with 6 mammæ in active service. A young one was found abroad on May 28th; most, however, appear in June, when half grown. They are incapable of breeding till their third year.[51]

TRAPS AND TROUBLES

Though a very timid animal, the Mountain Beaver, according to Camp, "will fight fiercely when in a trap. Its clumsy movements seldom permit of its inflicting the injury that its strong jaws and teeth are well fitted to produce. When in pain, milky white tears of a sticky nature cover the small eyes of the creature."[52] An eagle has been seen at watch with obvious ill-intent by the Beaver burrow.[53]

"Traps set in Aplodontia burrows have caught Weasels, Skunks (both *Spilogale* and *Mephitis*), Mink, and Gray-fox (Dixon, MS., 1909); and Coons (Lord, 1866, pp. 346–358), Badgers, Wildcats, Fishers (Lum, 1878, pp. 10–13), and owls are to be regarded as possible enemies. Redsquirrels, Rabbits and Ground-squirrels share the animals' burrows or forage about their litter,"[54] so are enemies in a small and parasitic sense.

Anthony testifies[55] that "The Showt'l probably is not very extensively preyed upon by hawks or owls, owing to the dense cover of vegetation beneath which he works, and also to his nocturnal habits. However, predaceous animals use his burrows and runways, for 2 Weasels (*Putorius saturatus*) were caught on successive nights in one runway; and I was told that Skunks

---

[49] Some data.

[50] W. A. N. A., p. 532.

[51] Some data.

[52] Excavations, p. 533.

[53] W. A. N. A., p. 53.

[54] Excavations, p. 533.

[55] Habits, pp. 58–59.

(*Spilogale*) were not uncommonly caught by the farmers in traps set for" this poor simpleton.

DAMAGE AND TRAPPING

In a few localities the underground Beaver "does some damage by eating crops and interfering with cultivation at the edges of the fields. Grinnell (MS., 1912) records it as causing trouble along the line of the Union Pacific Railroad over the central Sierra Nevada 'by burrowing in the ditch walls.' Shelton (MS., 1916) says that, in western Oregon, *Aplodontia* makes itself a nuisance to foresters by undermining trails and causing washouts."[56] In other words, it does an amount of damage about equal to what a baby would do with a wooden shovel.

As a climax, Prof. D. E. Lantz of the Biological Survey[57] reports that in western Washington, "considerable complaint has been made of their depredations of crops, particularly small fruits."

It is wise always to discount stories of farm depredations; this is well known. Anthony relates the following experience with Oregon residents. "It was suggested by the farmers that some of the inroads upon potato fields were made by Showt'ls, on account of the presence of burrows on the adjacent uncultivated land. Traps set in the potato fields, if at any distance from the waste lands, did not catch *Aplodontia*, and I collected no very positive evidence to condemn the animal. The large Ground-squirrel (*Citellus grammurus douglasii*) was quite common in this region, and the credit for the damage to farm produce must be given in greater part to this animal and to the Chipmunk (*Eutamias townsendi*). No unquestionable *Aplodontia* burrows were noted running out into the cultivated fields."[58]

"Mountain Beaver are easily captured," says Camp, "and the usual method of trapping them is to set No. 0, or No. 1 steel traps in the tunnel entrances. The Indians (in Oregon and Washington) says Cooper (1860, p. 82) catch the animal with 'stone fall traps.' He adds that the skins were not then being bought by the Hudson's Bay Company. Gibbs (in Suckley, 1860, pp. 100–106) relates how the Indians, probably the Nisqually tribe in Washington, 'trap and eat them and make garments by sewing the dried skins together.' The animals were there caught in traps 'resembling the figure-4 trap.' Skins of the California species bring only from 8 cents to 10 cents in the market, so there is little danger that the Mountain Beaver will be exterminated as a result of the fur trade."[59]

---

[56] Excavations, pp. 533–34.

[57] Destroying Rodent Pests. Yearbook U. S. Dep. Agri., 1917, p. 16.

[58] Habits, p. 58.

[59] Excavations, p. 534.

Gifts and Gait

As usual with creatures that shun the light and air, sight and hearing are dim and dull in the Mountain Beaver. Its contact with the outer world is chiefly through the sense of feeling, and this is highly developed all over its body. "The slightest touch upon a hair," says Camp, "will be responded to instantly by quick jerking movements. The sense of smell seems to be good, for the animal has a way of frequently raising its nose to sniff; also the scent glands are well developed."[60]

The Mountain Beaver has no need to be swift of foot. Strong feet to dig are worth more to him than speed, so his choice was made—he is a powerful digger, but slow above ground. Dr. J. G. Cooper says of these animals:

"A young man who had kept school at Astoria told me that the children sometimes caught them about the schoolhouse, where they burrowed, and that they could be caught by running after them, as they did not run fast."[61]

This implies a daylight appearance above ground that is interesting; and may correspond with the noonday outdoor activity of several species of Moles and mining Gophers.

Observations upon a Showt'l in captivity, have shown that, like *Thomomys*, it runs as easily backward as forward—a reverse-gear possibility that must be extremely useful in the narrow burrows.

Non-aquatic

Because it looks like a Muskrat and claims kinship with the Beaver, one might expect this animal to be highly aquatic. Some writers have assumed it to be so. Anthony, however, writes:

"Much has been made of the semi-aquatic tendencies of this animal, which has been credited with seeking sites where water courses sometimes were in part deflected into their burrows. This is doubtless often the case, for the Showt'l seeks abundant green vegetation, and this is oftenest found where there is water. However, Aplodontia shows no marked predilection for water, since in the humid coast-belt, where Tillamook is situated, the rainfall alone is sufficient to induce luxuriant vegetation, and here the comparatively dry hillsides harboured many families of the Showt'l. From the behaviour of my captive animal, I believe that water is tolerated when it is a necessary adjunct, but is avoided when sufficient food can be found otherwise. This may be so, however, only in the case of this species, and other forms may be more truly sub-aquatic."[62]

---

[60] Excavations, p. 532.

[61] U. S. Pac. R. R. Expl. XII, 1860, p. 82.

To this he adds of one that he captured: "This Showt'l was liberated on the bank of a small clear brook; and, as an experiment, he was put out into a fairly deep pool. He swam ashore showing no fear whatever of the water, but evidently displaying no particular fondness for it. He swam well and rapidly, and his unfrenzied procedure showed he had no dread of the water. He looked very much like a slowly swimming tailless Muskrat.

"Despite the fact that the Showt'l has been described in literature as being a water-loving animal, I do not think they ever swim from choice. He spent some time after coming ashore in shaking out his fur and going over his sides and belly before he felt sufficiently comfortable to begin eating."[63]

Dr. J. G. Cooper speaks of getting a specimen that was drowned in a tanner's vat[64]—which, if it proves anything, goes to show that the creature cannot maintain itself indefinitely afloat.

CLIMBS TREES

Perfectly logical naturalists have pointed out that, in view of its form and habits, the Mountain Beaver can no more climb a tree than can a Mole or a Muskrat. Then come the hunters and say, *But it does*. There can be no doubt, therefore, that this animal occasionally climbs. Camp writes:

"More than one writer, since Lewis and Clark, have mentioned the climbing habit of Mountain Beavers; and the evidence seems to be good that, at least, the Oregon and Washington coast species climb into low bushes for food (see Lum, 1878, pp. 10–13). The Mountain Beavers on the grounds of the University of Washington at Seattle have been seen climbing."[65]

Thus, it seems to climb about as much as our Woodchuck. And I suspect that, as with that animal, the climbing habit will be found oftenest in the young ones, for they are less removed from the ancestral stock, which most likely was a climbing animal.

A NIGHT BIRD

There can be little doubt that this grotesque and gloomy little creature is as strictly nocturnal as any creature is ever strictly anything. Anthony

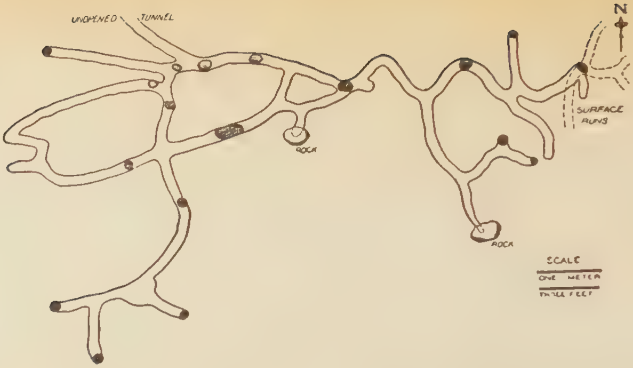
---

[62] Habits, p. 58.

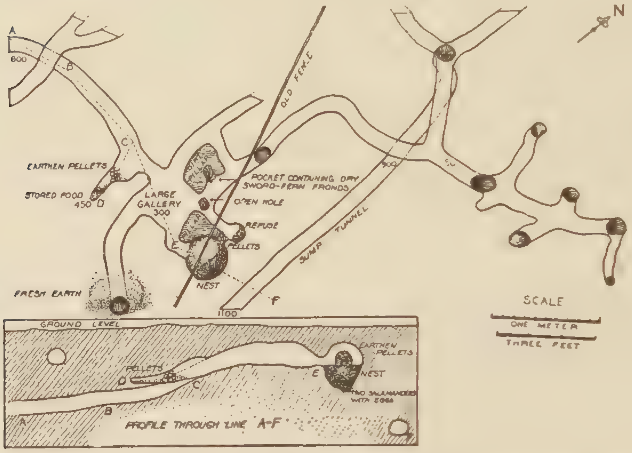
[63] As above, p. 56.

[64] Monog. Rod., p. 596.

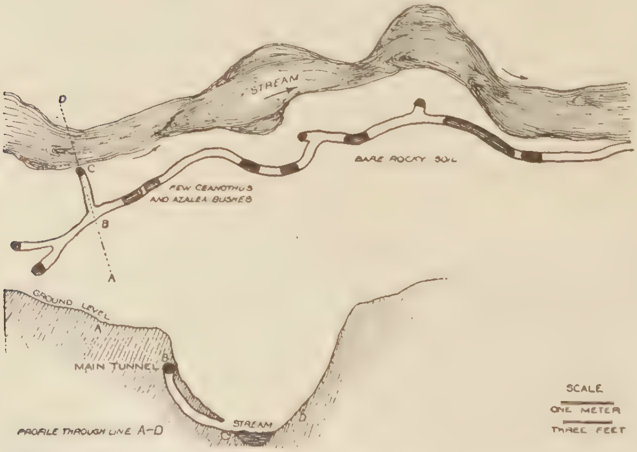
[65] Excavations, p. 530.



Plan of underground tunnels in colony of *Aplodontia rufa phaea* excavated near Point Reyes, Marin Co. Calif. All tunnels shown were within 600 millimeters of surface of ground



Plan and partial elevation of nest-galleries of *Aplodontia rufa phaea* excavated near Point Reyes, Marin Co., Calif. Numbers on plan indicate depth in millimeters beneath surface of ground



Plan and partial elevation of burrow system of *Aplodontia rufa californica* excavated at Chinquapin, Yosemite National Park, Calif.

PLATE LXIX.—BURROWS OF MOUNTAIN BEAVER

From Chas. L. Camp's Paper

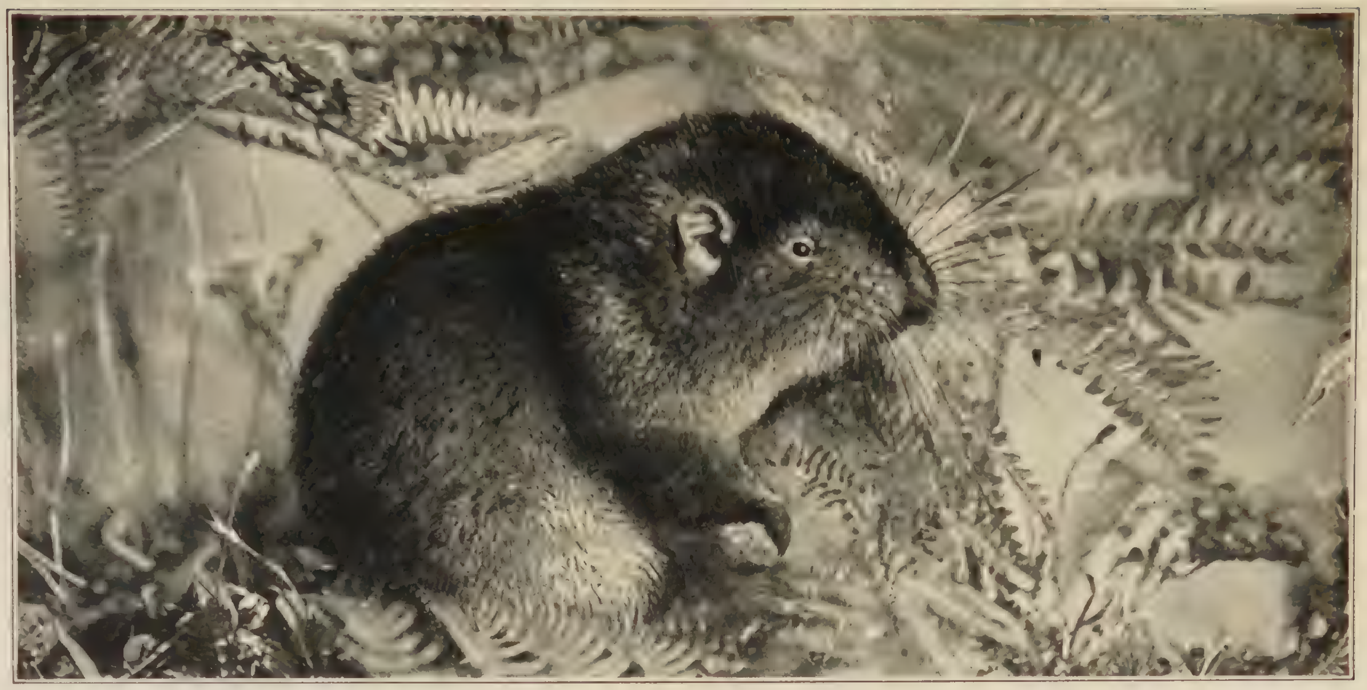


PLATE LXVI.—MOUNTAIN BEAVER IN THE ELK-BRAKE

Photograph by H. E. Anthony

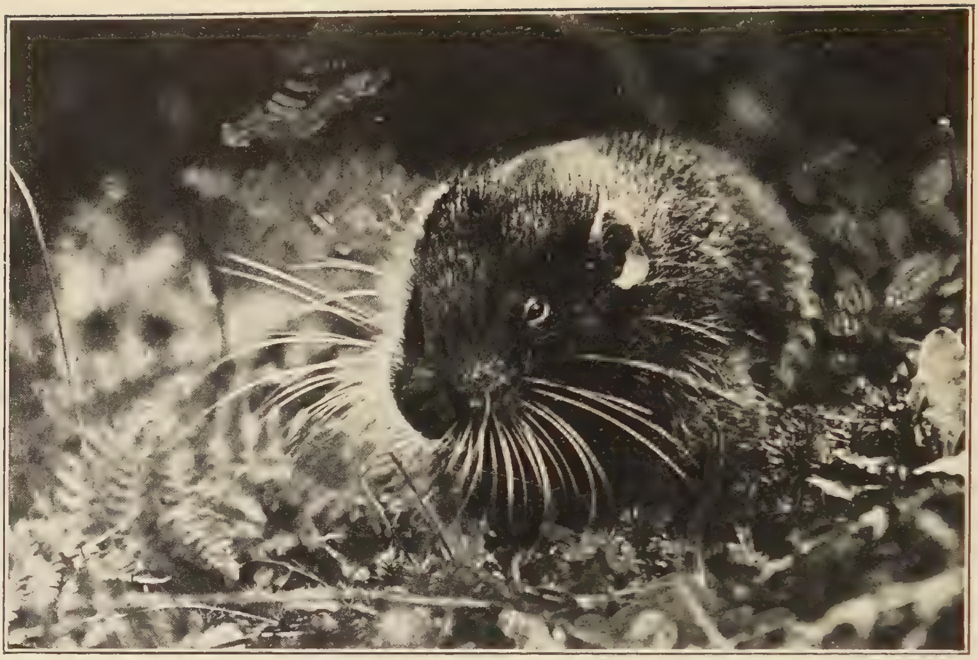


PLATE LXVII.—MOUNTAIN BEAVER, TO ILLUSTRATE WHISKERS
From photograph by H. E. Anthony

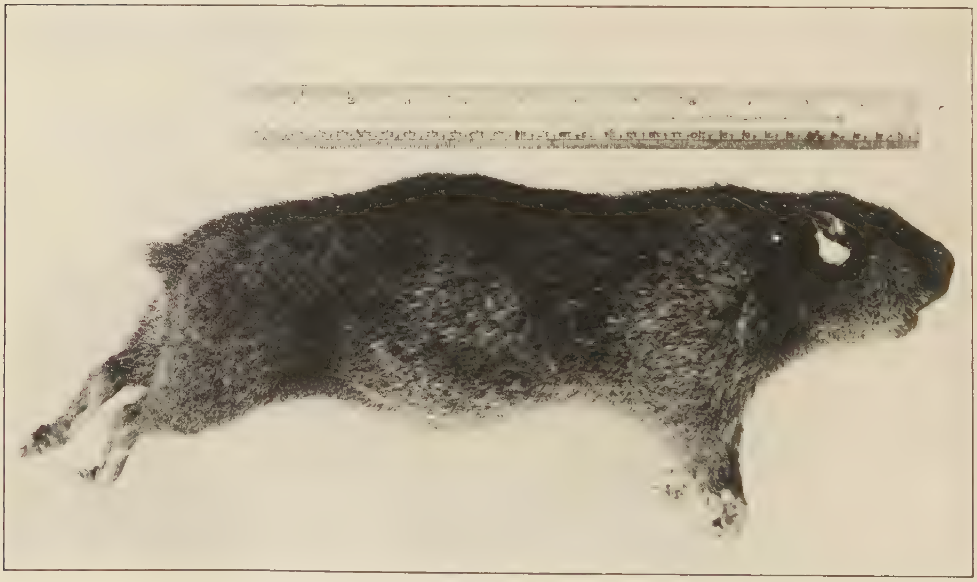


PLATE LXVIII.—MOUNTAIN BEAVER (DEAD)
From photograph supplied by the University of California. (Taylor's Revision)

says of those he investigated in Oregon: They "can rarely be seen during the day. Although a number of runways were visited, and I was daily in places where evidences of activity were manifest, I saw none of the animals themselves. Those caught in traps were frequently alive when the rounds were made in the morning."[66]

No Winter Sleeper

In the warm southern and southwestern parts of its range, where there is little or no white winter, the Mountain Beaver most assuredly loses not one day because of any hibernation. Camp says that in California the "Mountain Beaver, even in the high mountains, are certainly active during the winter. Near Olema, in Marin Co., [it] has been trapped at its burrow entrances, during the latter part of November. In the Yosemite National Park, at elevations of from 6,200 to 8,600 feet, [its] winter work . . . has been observed—young pine, fir and cedar trees with the limbs trimmed off up to 10 feet above the ground, and with twigs trimmed from one side of the trunk only, as if worked on when the trees were bent down in the snow. Azalea and other thickly growing bushes with the tops trimmed off evenly a foot or more above the ground, indicate that the animals probably forage on top of the snow."[67]

Going farther north into the land of hard winter, at least on the higher levels, Lum reports that in Oregon and Washington "they do not hibernate, but keep their burrows open all winter; beaten trails in the snow are often seen, leading above ground for a few feet from one hole to another. They are able to gather their food at any time of the year, seldom going more than a few feet from the entrance of their holes to procure it."[68]

Dr. J. G. Cooper says: "An old Indian hunter, who is now a shepherd in the employ of Dr. Tolmie at Puget's Sound, told him that he had frequently seen them running over the snow in the Nisqually Valley, so that they probably do not hibernate."[69]

"Suckley (in Suckley and Gibbs, 1860, p. 124) learned from the Nisqually Indians that the Mountain Beaver moves about a little during the winter but does 'not become decidedly active till late in the spring.' Lord (1866, pp. 346–358) maintains that the animal only partially hibernates—this of the species, in British Columbia. Matteson (1877, pp. 434–435) believes that it hibernates, covering the entrance of the burrow with stalks of leaves and fern. Bretherton (1895, p. 124) says that they do not hibernate."[70]

---

[66] Habits, pp. 53–54.

[67] Excavations, p. 531.

[68] Sewellel, pp. 10–13.

[69] Monog. Rod., p. 596.

It will be noticed that no one yet has offered the important physiological evidence of a vast accumulation of fat next the creature's skin in autumn, which is usual in hibernating animals.

"In winter," says Nelson, "much of the Mountain Beaver country is buried under several feet of snow, but this does not stop the activities of this hardy animal. Between the entrances to its burrows and out along the surface of the ground, it tunnels through the snow in various directions in search of forage.

"At this time, it cuts twigs from bushes and gnaws bark from the trunks and roots of the smaller trees, sometimes completely girdling and killing trees more than two feet in diameter."[71]

HIS WAY OF LIFE

This Mole-gnome of the thick woods seems to live a life as sombre as ever was pictured for the underworld gnomes of our fairy books. He seems positively to dread the sunshine.

Nelson testified that "Although mainly nocturnal, the animals are active early in the morning and late in the afternoon, as well as throughout dark days. Those kept in captivity would show periods of restless activity at night, and have alternating periods of sleep and wakefulness during the day. Sometimes they would sleep coiled with the head turned under the body, and again flat on their backs. During these periods, their sleep is often so profound that they may be handled without being awakened."[72]

Allan Brooks offers some light on the creature's gifts and little mind. "The eyes," he says, "are exceedingly small, and generally covered with a milky film; they do not seem to be of any use to the animal, as the following incident will show. I had set a trap in the mouth of a hole, and next morning found two 'Mountain Beavers' jammed in the hole, fighting the trap. I thought at first both were caught, and got down on my hands and knees to examine them, when I saw that only one foot was in the trap. After careful selection, I grabbed by the nape of the neck, as I thought, the free animal, and dragged it out, but found I had the trapped one. The other bolted down the hole before I could make another grab.

"Another time I wished to liberate one which was almost without hair on the anterior half of its body, and therefore of little value as a specimen.

---

[70] Excavations, p. 530.

[71] W. A. N. A., p. 532.

[72] As above.

I sprung the jaws of the trap open, while the animal made a vigorous onslaught on my feet. When free, it still continued to fight. Twice I kicked it down its hole, only to have it rush out and attack my feet again. The third time, it scuttled down its hole out of sight."[73]

Anthony's observations on captives of this species, are the most minute and complete that are available. He says:

"Showt'ls, when caught in the trap without serious injury, are very pugnacious; and at such times, when two are brought together, fight ferociously. They will bite fiercely at sticks or any objects thrust near them, and I imagine that, under ordinary circumstances, this pugnacity would serve to keep the inhabitants of a series of burrows few in number. Their resemblance in behaviour to the Pocket-gopher, under similar conditions, indicates that the Showt'l may have the same surly home life.

"An animal caught in a steel trap by the leg, but with no bones broken, was found the morning of July 28, and was kept alive to observe his habits. He was very aggressive while in the trap; and when brought near another captive, also uninjured, after the first tussle, he created such a respectful attitude in Showt'l No. 2, that the latter strained at the chain to keep out of his reach. They were separated before either had been hurt, for the powerful incisors and strong jaw muscles are capable of giving deep wounds. While in the trap, great care in handling the animal had to be exercised. He was placed in a box, and kept from escaping by a board laid across the top.

"Before he had been in captivity 24 hours, he was taken out to be photographed. A wire fastened to a hind leg prevented escape; and he was put down in a spot resembling his habitat.

"After several determined efforts at escape, he suddenly stopped his struggles, and grabbing a tender young shoot of the 'elk-brake' by which he was surrounded, proceeded to feed as quietly and as unconcernedly as if he were perfectly free. He was quite touchy, however, and any sudden movement brought forth an attempt at freedom. He sat up a great part of the time, and if annoyed while in this attitude sparred like a Bear with his forepaws, showing a perfect control of his position. . . .

"This captive animal washed his face after the manner of small mammals, reaching back with the forepaws onto his shoulders and hinder neck readily, the movements being short, quick dabs. When irritated, he twitched the whiskers energetically; and when most angry uttered a husky querulous note somewhat like a cough. He often satisfied his curiosity by sniffing and working his nose, and this member seemed to be very sensitive, for the slightest blowing upon it produced spasmodic starts. When aroused, his eyes had a bright alert appearance, but quickly took on a dull listlessness when the animal relaxed at ease.

---

[73] Recreation, p. 259.

"His body was very hard and firm to the touch. When running loose on the floor and I put my hand upon him, he seemed to brace himself and became rigid at times. He could give sharp scratches when held, but did not seem to be able to squirm very effectually because of his short thick neck and the heavy musculature of the fore parts.

"By the end of a week, he had become so tame that he never offered to bite. He seemed to accept the conditions as inevitable, and, not showing any appreciation of caress that some tame animals display, his attitude was one of complete indifference.

"He soon cut off the toes from the foot that had been pinched in the trap, but evinced no concern over the fact. No attempt was made to gnaw out of the box that kept him prisoner."[74]

This individual was in captivity for weeks, and at least enabled us to get a glimpse of his home habits.

But the species seems to be too sensitive and too specialized for cage life, and practically all attempts to keep it indefinitely a captive have failed. Though it seems to eat freely and live contentedly, it does not thrive, but dies early for no obvious reason.

Unsociable and Gloomy

Although found in colonies like the Muskrat—by reason, perhaps, of the abundant food supply at a given spot—the Mountain Beaver is not sociable in the sense that the Beaver is. It does not unite its efforts for some common good, such as a common nest, or a common food supply, unless digging long connecting tunnels can be considered a joint and sociable under taking.

This unsociable bent is further shown in the total absence (so far as known) of mud-pie communication (see Beaver Life, p. 480), or of any large nest that is resorted to by many, in the way of a club-house; as well as the practical absence of voice, according to many observers—with, however, two notable exceptions that are set forth later. Nevertheless, we are not equipped with full observations, and a complete change of ideas is quite possible in view of the following facts: The species does live in colonies; and it has a strong musky smell. Such smells are usually associated with some method of communication, which presupposes ideas, and the wish to communicate them.

---

[74] Habits, pp. 55–57.

The Voice of the Silent One

What of the Mountain Beaver's voice? Is he mute, as some maintain; has he one or two simple sounds, and these but rarely uttered; or has he a large vocabulary to be used on occasion?

Let us remember that the creature has vocal apparatus, and, living in the dark, has more use for sounds than his very vocal relatives, the Marmots, which live in daylight; that, therefore, he probably has a large number of sounds, including a song. But he is so shy and secretive in habits, that these have escaped notice.

In reviewing the testimony, it will be noted that, according to most, the creature is silent or nearly so. In which connection, it is well to recall that Wilson said of the hermit thrush: "It has no song." What he should have said was: "I have not heard it sing." Precisely the same warning is due the various naturalists herein quoted, who have given us pictures of the "sullen, silent Mountain Beaver." As illustrations of their attitudes, note the following:

"The only sound that we have known the Mountain Beaver to make, is a singular grating noise produced when the animal is alarmed, by rasping the lower incisors laterally across the tips of the upper. I have seen Pocket-gophers, Marmots, and Copperheaded Ground-squirrels (*Callospermophilus*) do the same when terrified."[75]

Lum[76] has never known it to make any sound by day or night, "save a kind of growl when caught in a trap."

But closer observation, especially that which was effected through Indian contacts, yielded some wholly new ideas. Thus: Suckley and Gibbs[77] quote a certain Col. Simmons as saying that he had seen Mountain Beavers "sitting at the entrances of their burrows early in the morning, and whistling something in the manner of the Prairie-dog." F. S. Matteson[78] reports that the *Aplodontia* in Oregon "is generally known as Mountain Boomer from his habit of making a kind of booming noise."

W. W. Price[79] speaks of a shrill cry heard several times when he was near a colony of Mountain Beaver.

Nelson, in his recent work (1918) records that one captive animal is reported to have uttered a curious quavering note resembling that of a screech-owl.[80] The soft tremolo of this owl is thought by many to be the sweetest and most characteristic voice of the autumn woods.

---

[75] Camp, Excavations, p. 532.

[76] 1878, pp. 10–13.

[77] U. S. Pac. R. R. Expl., XII, 1860, p. 125.

[78] Mt. Boomer, Amer. Nat., XI, 1877, pp. 434–35.

[79] Notes on Coll. Mamm. Sierra Nev., Zoe, IV, 1894, p. 328.

That is, in fact, each new observer adds to the list of pleasant and varied sounds that the Mountain Beaver utters. He is no longer the mute and sullen. Whether the parallel of the hermit thrush will be maintained—who can tell?

THE GNOMES' REVELRY

Notwithstanding this slow rebuttal of the "dead silence" idea, we are not fully prepared for the picturesque account of J. K. Lord, which would make of this voiceless one the leader of the wildest chorus in the calm, still autumn woods. Some critics have been disposed to question the accuracy of his observations, but we must not forget that Lord was a trained and careful naturalist. There are many corroborative scraps of testimony, the Indians endorsed his account, and his experience with the Mountain Beaver is exactly paralleled by other writers' experiences with Lynx, Cougar, alligator, digger toad, etc.—creatures long listed as silent, because usually they are silent, but which have proven to be at times given to the most terrific and continuous outcries.

In the end of the Indian summer, 1860, Lord, the naturalist of the British Columbia Boundary Survey, was camped in the woods along the Chilukweyak River at its junction with the Fraser. He was enjoying the calm closing of a perfect autumn day. In his narrative he dwells on the intense silence of the great forest; then writes as follows:

"This silence was suddenly broken, as was my reverie, by a sharp ringing whistle; it was so piercing and clear, that I could not believe it was produced by an animal. Hardly had it died away, when another Whistler took it up, then a third, and so on, until at least a dozen had joined in the chorus. I stole carefully in the direction from which the sound came, but as I neared the spot the whistle ceased, and it was now far too dark to descry any object on the ground. So, in doubt, and sorely puzzled to account for such an unusual sound, and with a firm determination to unravel the mystery in the morning, I returned to my camp. Could it be Indians? No, impossible; there were far too many Whistlers, and the tone of each whistle was precisely alike. I was equally sure it was not the cry of the Rock-whistler (*Arctomys*); that sound I knew too well. What could it be?

"As the gray light of morning came peering into my tent, I started off to investigate the secret of the mysterious Whistler; but all I could discover, after a long and diligent search, was, that there were numerous runs and burrows excavated in the sandy banks of the river, but by what sort of animal I could not for the life of me guess. Setting a steel-trap at the entrance to one of the holes, I strolled down to the Indian village, thinking I should possibly be able to find out from the redskins what it was that made such shrill sounds. Partly by signs, and by using as much of their language as I knew, I endeavoured to make the old chief comprehend my queries.

---

[80] W. A. N. A., p. 532.

"After attentively watching my absurd attempts to produce a ringing whistle by placing my fingers in my mouth, and blowing through them until my face was like an apoplectic coachman's, a smile of intelligence lit up his swarthy visage: then I violently dug imaginary holes, and explained that the sounds came about twilight; he nodded his head, dived into the tent, and disappeared in the smoke, to shortly emerge again with a rug or robe, made from the skins of an animal that was quite new to me.

"It was beautifully soft, glossy, and brown. The skins were about the size of a large Rat's, and about twenty in number. Here, then, was the dawn of a discovery. He called the animal *Ou-ka-la*, and made me understand that it lived on roots and vegetable matter, and burrowed holes in the ground.

"As the daylight faded out, I again took my seat; and, just as before, when everything was silent, the woods echoed with the Ou-ka-la's cry. I longed for morning, and hardly waited for light, but hastened off to my trap; and, joy of joys, I had one sure enough, caught by the neck. Poor Ou-ka-la! your friends had heard, and you had given, your 'last whistle.' He was dead and cold—trapped, perhaps, whilst I listened wonderingly, keeping my lonely vigil. A very brief examination revealed the fact that I had caught a magnificent specimen of the *Aplodontia leporina*, of which I had only read."[81]

The Forest Gnome

For over a hundred years now we have known this subsoil Brownie. In the books, he has been given a place and a name, but we have learned little of his way of life. We know the shape of his body, but not the purpose of his bristling antennæ. We know the whereabouts of his underground village, but little of his habits and calendar, and nothing of his love-making, his amusements, his wireless code, his preparation for famine, his combat with disease, or his outlook on life.

The episode related by Lord may have been a national rejoicing over some good happening—we don't know. And we ask, why has no other naturalist recorded it?

I am restrained from incredulity by a personal remembrance.

---

[81] Naturalist, Vancouver Id., I, pp. 348–51.

For years, I worked as a student in the London Zoo, and daily saw the great, logy alligators like dead things in their warm pool. A slow, oozy change of position, a slow half-blink, or a slow slide into water, were the rare symptoms of life they showed.

But one day, the big bull 'gator opened his cavernous mouth a little, and let off a long, deep, raucous bellow. The others joined in—20 or 30 of them—big and little—and each, in measure of his size and strength, contributed his bellow, again and again, till the building rang and vibrated with an uproar like a hundred bulls in battle. It was terrific. Visitors came running to see; or, in some cases, fled in fear. It lasted for fifteen minutes, then died away. The big mouths closed like clams, and the log-like life was resumed.

The keeper said: "I have been here since I was a young man, and I have heard that only two or three times. Some who have been here for years, never heard it till now."

In Taylor's Review of our forest gnome, he lists some 29 Indian names that have been given to this odd creature. He does not interpret them; but some, we know, refer to its digging, others seem to connote that this is a whistler of the woods. Will not some one of our wise woodmen equip himself with knowledge of the red-man's viewpoint as well as his own, and solve for us a little at least of the delightful mystery that still surrounds Ou-ka-la Haplodon?

We have always seen him as a hunted, hounded, tortured prisoner, sullen, silent, and defiant. Maybe, if we know him better, he would prove a merry creature of the under-fern-world, happy with his own people, joyous at times, and as jubilant vocally as that noblest of our Northern songsters that we were once assured by the leading authority "had no song."

REFERENCES

1860—Report (*Aplodontia leporina*) by G. Suckley, Zool. Rep. U. S. Pac. R. R. Expl. & Surv., 12, p. 100.

1866—The Naturalist in Vancouver Island and British Columbia, by John Keast Lord, I, pp. 348–51 (London, Brentley).

1877—Monographs of North American Rodentia, by Elliott Coues and J. A. Allen, pp. 543–600.

1878—The Sewellel or Showt'l, by S. K. Lum., *Amer. Nat.*, 12, Jan., pp. 10–13.

1886—Description of a New Species of Aplodontia (*Aplodontia major*) sp. nov.) from California, by C. H. Merriam, *Ann. N. Y. Acad. Sci.*, 3, No. 10, pp. 312–28; 2 pl., 1 fig.

1887—Field-notes on the Mammals, Birds and Reptiles of Northern California, by C. H. Townsend. Proc. U. S. Nat. Mus., 10, pp. 174–75.

1899—Results of a Biological Survey of Mount Shasta, California, by C. Hart Merriam. *N. A. F.* 16, pp. 92–93.

1899—The Sewellel, *Aplodontia rufa*, by Allan Brooks, *Recreation*, Oct., pp. 258–59; 1 half-tone.

1916—Habits of Aplodontia, by H. E. Anthony. Bull. Amer. Mus. Nat. Hist., 35, pp. 53–63; 8 figs. On this, and C. L. Camp's paper chiefly this life-history is founded.

1918—Revision of the Rodent Genus Aplodontia, by W. P. Taylor. Univ. Calif. Publ. Zool., 17, pp. 435–504; pls. 25–29; 16 figs. in text.

1918—Excavations of Burrows of the Rodent Aplodontia, etc., by Charles L. Camp, Univ. Calif., 17, No. 18, pp. 517–36; 6 figs.

1918—Wild Animals of North America, by E. W. Nelson, pp. 529–33.

1922—Some Data upon the Rodent Aplodontia, by C. Andreson Hubbard, "The Murrelet," Seattle, Wash., Jan., pp. 14–18.

LIFE LXXXVIII—ROUND-TAILED MUSKRAT

PAGE
Names 558
Description: Size, Weight, Colour 558
Races 558
History 558
Range 559
Haunts 559
Numbers 561
Tunnels 561
The Round-house 562
Breeding and Young 563
Food 563
Enemies and Parasites 564
Habits 564

References 565

Round-tailed Muskrat, Water-rat, Prairie-rat, Allen's Muskrat, Muskrat Mouse, File-tailed Rat, Crib Rat, Roller-tail

Neofiber alleni True

(Gr. *neos*, new; *Fiber*, a Beaver, formerly used as the generic name of the Common Muskrat; *alleni*, in honour of J. A. Allen)

Neofiber alleni TRUE, 1884, Science, Vol. IV, p. 34. July 11.

Type Locality—Georgiana, Brevard Co., Fla.

The genus *Neofiber* (True, 1884) was founded expressly to contain and advertise this remarkable species. It is, to all intents and purposes, a large Field-mouse, differing from *Microtus* chiefly in size. Nevertheless, its skull, dentition, and fur are much like those of *Ondatra*, which is simply a large edition of *Microtus*. But *Neofiber* differs from *Ondatra* and resembles *Microtus* in having the tail round.

The Round-tailed Muskrat has, in addition to the generic characters as above, the following:

Size. Length, about 13 in. (339 mm.); tail, 5 in. (127 mm.); hind foot, 1¾ in. (44 mm.).

Weight. Exact weights are not at hand, but a safe general statement is that it is less than half as big as a Muskrat, and weighs about ¾ lb.

Colour. At a distance, *Neofiber*, looks much like *Ondatra;* that is, the Water-rat might pass for a young Muskrat. Above, it is of a rich brown, darker on the head; shaded on the underparts into buffy or pale rufous; the feet, brownish; behind the shoulder, the base of the hairs is white.

RACES

Two forms of *Neofiber* have been described:

- *alleni* True, the typical form. T. l., Georgiana, Fla.
- *nigrescens* Howell, a dark inland race; more blackish above, and more whitish below. T. l., Ritta, Lake Okeechobee, Fla.

HISTORY

This discovery of *Neofiber* in Florida was one of the great surprises in modern natural history. We must remember that it exists in abundance; it is easily trapped; and the conspicuous nests are thickly studded on thousands of ponds. Yet, of all the multitude of naturalists that have visited Florida since Bartram's time, not one had the luck to collect a specimen until, in 1884, it fell to the lot of Fritz Ulrich to get the type which Dr. Wittfield sent to Dr. Frederick W. True.

RANGE

In Florida and southern Georgia, this species replaces the Common Muskrat. Its "range can perhaps be best expressed as follows: Florida, from the East Peninsula west at least to Gainesville, Lake Okeechobee, the vicinity of Chokoloskee, and Cape Sable; also southeastern Georgia (Okefinokee Swamp). *Alleni* is found on the East Coast, and *nigrescens* seems to occupy the remainder of the range of the species."[1]

HAUNTS

Chapman, speaking of East Peninsula, opposite Micco, Fla., says: "At this point, the peninsula is about half a mile in width, a fringe of outlying mangrove-bordered islands on the west shore increasing the distance from river to ocean to somewhat more than a mile. The growth on the peninsula proper is very dense, and composed largely of cabbage palms and oaks; the sea coast being bordered by an unbroken line of saw-palmetto several hundred yards in width; while on the river side, frequent inroads are made by large savannas caused by inflowing streams. On these savannas, which occur also in the interior of many of the islands before mentioned, *Neofiber alleni* may be found in abundance.

"The growth here is largely restricted to the heavy fringe of red and black mangrove and 'sedge' facing the water, with occasional black or 'yellow mangroves' dotting the surface of the savannas irregularly throughout their entire extent. Though subject to frequent inundation, the water rarely or never rises above the tangled mass of grass, which, at the time of my visit, was from 2 to 3 feet high, and densely matted underfoot."[2]

According to Bangs, it is found "on the salt savannahs of the Indian River, living in underground runways, often full of water, and around the edges of the pools of salt water"; also "in the fresh-water ponds and marshes of interior Florida."[3]

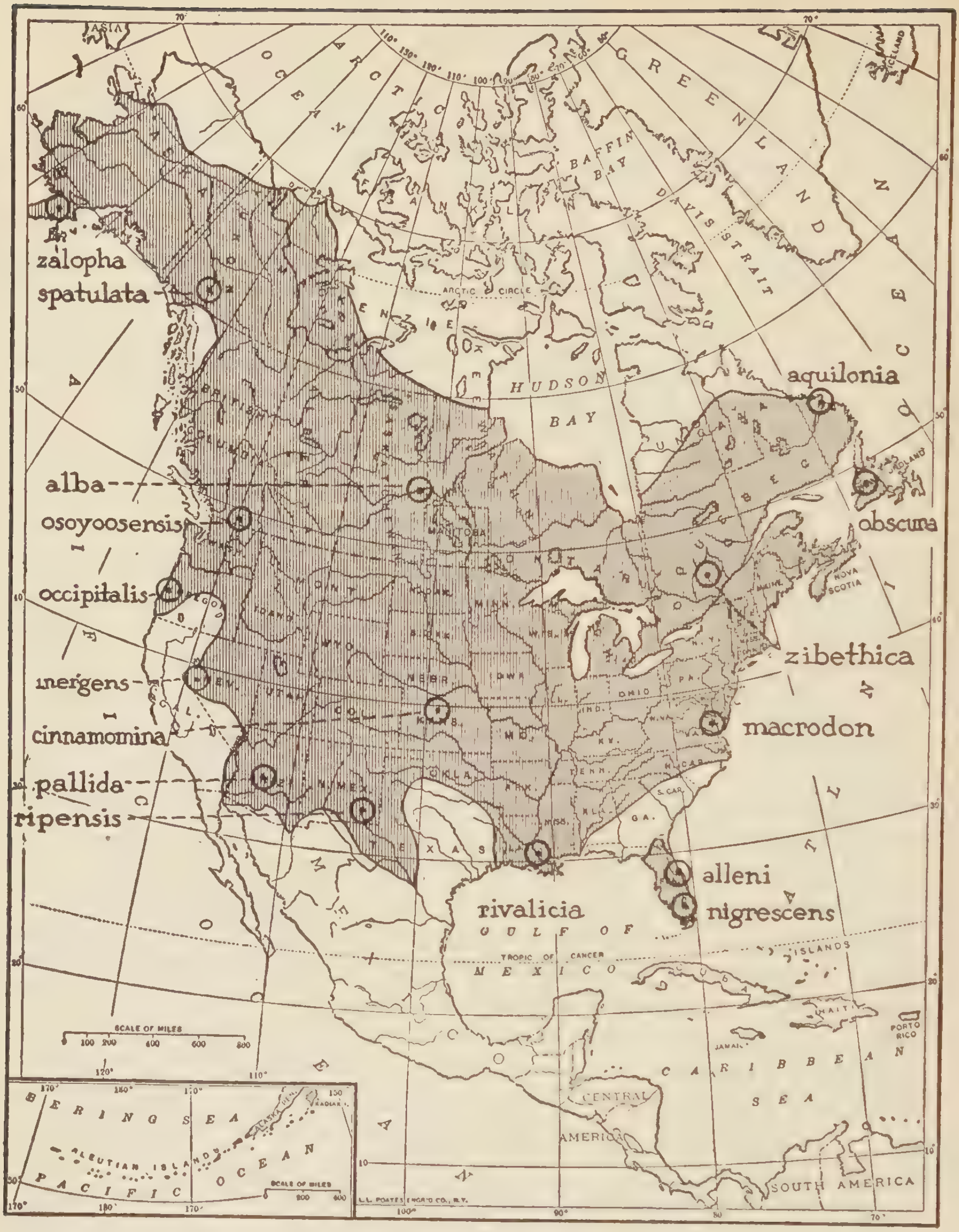
These remarks apply mainly to the race *alleni*. In direct contrast, Howell says of *nigrescens*: "In the Okeechobee region, the animals are found,

---

[1] Francis Harper, MS.

[2] Habits, pp. 119–20.

[3] Mammals Fla. & Ga., pp. 182–183.



MAP XV.—RANGE OF THE COMMON MUSKRAT, AND OF THE ROUND-TAILED MUSKRAT

By E. T. Seton, with assistance of the Biological Survey, 1927

not in ponds or marshes, but in dry or moist peat at a considerable distance from the lake shore. Before the lowering of the lake by drainage canals, however, the water must have extended close to the areas occupied by the Rats, and probably at times, overflowed them."[4]

NUMBERS

In 1884, because of our ignorance, *Neofiber* was considered the rarest mammal in North America—"merely, however," as George N. Lawrence remarked to me at the time, "because we have not found its country and its metropolis. Once these are located, it will be common enough."

In justification of this, note the following: On the savannahs of the East Peninsula, opposite Micco, Fla., says Chapman, "*Neofiber alleni* may be found in abundance."[5] It occurs on Indian River "in great numbers," says Bangs; to which he adds: "At Oak Lodge, I trapped 7"; and again, near Gainesville, "they were very abundant. . . . I caught 14 Rats in a few days."[6]

Bangs continues: "At Oak Lodge . . . it was not common . . . there at the time of my visit, owing to very heavy floods of about a year before, which, according to Mr. Latham, who had studied the Rats carefully for a long time, had almost exterminated it."[7]

Dr. Francis Harper writes me that "its numbers in the Okefinokee may easily reach 10,000 individuals."

TUNNELS

The tunnels or runs of this Rat remind us at once that the species is near kin of the Meadow-mice. Howell says of those he saw in the Okeechobee region:

"Their burrows or tunnels were found in both neglected and cultivated fields, in cane patches, and even in dooryards and gardens. In the largest colony discovered, the tunnels ramified the friable peat soil in all directions, but apparently extended to no great depth; only small mounds of peat were found about the entrances. . . .

"In a small brackish marsh at the head of Barnes River, about 8 miles east of Chokoloskee, I found a small colony of these Water-rats, and trapped a single specimen. This is the first record from the west coast of Florida;

---

[4] New Race, p. 80.

[5] Habits, p. 119.

[6] Mammals Fla. & Ga., pp. 182–83.

[7] As above, p. 182.

but residents stated that the animals are abundant in similar situations near the head of Turner's River; and doubtless all the way down to the coast to Cape Sable. At this locality, their tunnels were in wet muck in a part of the marsh containing a dense growth of switch grass with much of the old growth matted down on the ground. Good-sized piles of muck had been scratched out of some of the burrows; and, in a few cases, the holes had been plugged with a round ball of soft muck. Deep trails led from one hole to another, but I could not find that any trails led to the pond a few yards away where cattail flags grew abundantly. Many pieces of flag stems, presumably cut by the Rats, were floating on the water."[8]

The Round-house

The round-house, as the Round-tailed Muskrat's house may be called for short, is somewhat like that of its big, wet cousin, the Muskrat; and yet is not found in deep water, and is built without mud. It has some resemblance to the rubbish pile of the Packrat.

Bangs writes: "It makes its breeding nest in an old stump, at the base of a black mango, or in a clump of bushes. . . . At the wet prairie near Gainesville . . . they were very abundant; and in early April, when I was there, they were busily engaged in making large nests in the water bushes, *Cephalanthus*. The nests rested on the water, and had two entrances from below; they were built of water-lily stems, reeds, grass, and the green leaves of *Sagittaria* and *Pontederia*. The water below the nests was from a foot to two and a half feet deep. . . .

"At other times, I saw them at work on their nests, generally pushing material up from inside; and once, one came out and arranged some leaves on top of his house, working very fast with his fore feet; while I watched, he suddenly vanished, and I could not tell whether he slipped off into the water, or went down into his nest. I could not account for not seeing them swimming about, or gathering material; as they evidently work in the daytime, and were often engaged in house-building while I was watching them."[9]

In further detail, Dr. Francis Harper says of those he saw in Okefinokee: "The height of several nests that were somewhat closely examined, varied from about 12 to 18 inches; the diameter, from 12 to 24 inches (and in one case about a yard). The fresh nests appear nearly globular; the older ones become somewhat depressed. They are built apparently of whatever vegetable material is conveniently at hand. . . .

---

[8] New Race, p. 80.

[9] Mammals Fla. & Ga., pp. 182–83.

"The chamber is just about large enough to enable the animal to turn around in it comfortably. Its floor is slightly elevated above the water-level, and is usually damp or moist. There are invariably two entrances, or exits, on opposite sides of the chamber. They are in the form of tunnels which slant downward into the bog, and are filled with water and peaty sediment nearly to the level of the floor of the chamber. The tunnels are probably about 3 inches in diameter. The chamber is really little more than a slight enlargement of the tunnel where it rises out of the bog to pass through the nest. There is generally a space of 4 to 6 inches between the two entrances, but occasionally more.

"In several nests examined on Floyd's Island Prairie in January, 1917, the chamber was occupied by a little bed of soft and fairly dry vegetation, distinct from the mass of the nest; probably this was a place for the reception of the young. None of the nests opened during the summer months have revealed such beds."[10]

Breeding and Young

Concerning the breeding, Harper says: "Our first specimens from the Okefinokee were obtained on Jan. 5, 1917, when Jackson Lee brought in an adult male from our traps on Floyd's Island Prairie, and also two very young and scantily haired individuals, which he had found in a nest. They had been born so recently that their navels were not fully healed, and their eyes were not open. Three days later, two other specimens (a subadult male and an adult female) were obtained on this prairie. The immature individual caught alive on June 18, was probably no more than a couple of months old. From these meagre data, it appears that the breeding season extends from January at least to April, and very likely into the fall."[11]

Food

Chapman says:[12] "Here *Neofiber* finds what apparently is a favourite food, in a species of succulent grass, which grows to a height of three or four feet in water half as deep. To procure the younger and more tender portions of this grass, he constructs a platform of the larger stalks, on which he sits and feeds at leisure on the shoots growing in his immediate vicinity; and the size of this supporting platform depends on the abundance of food growing near it, the harder, rejected portions of grass constantly adding to its bulk.

---

[10] Okefinokee Swamp, pp. 212–13.

[11] As above, pp. 216–17.

[12] Habits, pp. 120–21.

The largest one observed, measured about 12 by 10 inches, and rested on the bottom in water one foot deep.

"Occasionally, during a period of high water, an overhanging and submerged limb of black mangrove will furnish a basal support for this stand, which the receding water leaves suspended. In one instance, the cigar-shaped shoot of a red mangrove, from which the bark had been partially gnawed, was found on a feeding platform; while the stomachs of the specimens examined contained only vegetable matter, which we may presume, largely, if not entirely, composes the food of this species."

Howell found them easily caught in "traps baited with banana."[13]

Enemies and Parasites

In listing the probable enemies of the Roundtail, Harper mentions most of the predaceous birds, beasts, and reptiles of the region; but adds that its nocturnal habits give the species a large measure of immunity from hawk attack. Also: "The apparently habitual use by Neofiber of its nest chamber as a feeding-place, has the advantage of furnishing practically complete security from such enemies as owls, though some of the snakes might easily penetrate this retreat, either through the sides or by means of the tunnels."[14]

A hint of what may be a more troublesome pest is found in the following. "In June," says Harper, "on Floyd's Island Prairie, it seemed strange to find nearly all of the old nests so thoroughly infested with ants that the builders could scarcely have continued inhabiting them. Apparently, the new nests were not so infested; they seemed more or less isolated in sparse vegetation, which the ants could scarcely reach across the intervening spaces. Just how seriously these pests may affect or disturb Neofiber's domestic economy, is a question not yet determined."[15]

Habits

Chapman continues: "Though I was frequently on the water at night, both with and without a headlight, *Neofiber* was not once observed swimming, as we so often find the Muskrat—an observation confirmed by the experience of Mr. Latham, who has passed several years in the locality.

"It is probable that *Neofiber* is much less aquatic than the last named species [the Muskrat], a fact which would largely account for the differences observed in their habits.

---

[13] New Race, p. 80.

[14] Okefinokee Swamp, p. 216.

[15] As above, p. 213.

"That *Neofiber* is quite at home in the water, however, was clearly shown by the actions of a captured individual, which, placed in a tub of water, swam and dived readily; in swimming using the tail in a peculiar gyratory manner, the tip describing circles."[16]

Bangs says: "By carefully removing the tops of the nests, placing a steel trap on the little platform between the two entrances, and then replacing the roof, I caught 14 Rats in a few days; many others left a foot apiece behind them, but escaped. Several times, when I had just taken the top off a nest, I saw the Rat dart like a flash up one hole and down the other."[17]

REFERENCES

1889—On the Habits of the Roundtailed Muskrat (*Neofiber alleni* True), by Frank M. Chapman, Bull. Am. Mus. Nat. Hist., II, pp. 119-20.

1898—The Land Mammals of Peninsular Florida and the Coast Region of Georgia, by Outram Bangs, Proc. Bost. Soc. Nat. Hist., Vol. 28, pp. 182–83.

1901—A List of Mammals Obtained by Thaddeus Surber, in North and South Carolina, Georgia, and Florida, by D. G. Elliot, Field Columb. Mus., Publ. 58, Zool. Ser., Vol. 3, pp. 31–57.

1920—Description of a New Race of the Florida Water-rat (*Neofiber alleni*), by Arthur H. Howell, *Journ. Mamm.*, Feb., pp. 79–80.

1927—The Mammals of the Okefinokee Swamp Region of Georgia, by Dr. Francis Harper, Proc. Bost. Soc. Nat. Hist., Vol. 38, pp. 191–220

---

[16] Habits, p. 121.

[17] Mamm. Fla. & Ga., p. 183.

LIFE LXXXIX THE MUSKRAT

PAGE
Names 569
Description: Size, Weight, Colour 569
Races 570
Range 571
Muskrats in Central Europe 571
Home Range 572
Haunts and Migration 574
Shifting Populations 574
Numbers 575
The Fur 577
The Flesh 578
How to Trap the Muskrat 578
A Freak Foot 578
Speed and Powers 580
Play-game 581
Food 581
As a Clam-eater 582
Fish and Flesh 583
Storage 584
A Muskrat Silo 585
Social Calls and Usage 585
A Little Brother to the Beaver 586
The Bank-den 586
Tunnels 587
The Rat-lodge 588
The Rat-raft 590
Eating-huts 590
Jetties 591
Hauling Docks 591
The Foes of Wah-jusk 592
A Desperate Fighter 594
Fighting for Mates 596
Their Mode of Marriage 597

PAGE
Breeding 598
The Musklings 599
The Heroic Mother 600

References 601

Muskrat, Mushrat, Musquash, Musk-beaver, Ondatra, or Mudcat

Ondatra zibethica (Linnæus)

(*Ondatra*, the Indian name. L. *zibethica*, adapted from the root of "Zibet" or "Civet," the Musk-cat of the Old World, applied to the Muskrat on account of its odour)

[*Castor*] *zibethicus* LINNÆUS, 1766, Syst. Nat., XII, I, p. 79.
[*Ondatra*] *zibethicus* LINK, 1795, Beyträge z. Naturgesch., I, Pt. 2, p. 76.

Type Locality—Eastern Canada, i. e., Quebec

FRENCH CANADIAN, *l'Ondatra*, or *le Rat musqué*.
CREE, *Was-usk'*, *Wah-chusk'*, or *Wat-susk'*.
SAUTEAUX, *Wah-sesk'*.
OJIBWAY, *Wah-jusk'*.
CHIPEWYAN, *Dthen*.
YANKTON SIOUX, *Tsink-pay*.
OGALLALA SIOUX, *Sink-pay-lah*.

The genus *Ondatra* (Link, 1795) comprises animals which, in anatomy, are simply huge Meadow-mice, with naked tails flattened on the sides. The Muskrat is the type of the genus.

The teeth are as in *Microtus*, i.e.:

$$\text{Inc. } \frac{1-1}{1-1}\text{; mol. } \frac{3-3}{3-3} = 16$$

When seen alive, its size, flat naked tail, aquatic habits, and the dark crown with buffy cheeks, will identify it.

In addition to the generic characters, the Muskrat has:

Size. Length, 21 in. (532 mm.); tail, 10 in. (254 mm.); hind foot, $3\frac{1}{2}$ in. (89 mm.).

Weight. Of 8 Muskrats, captured at Carberry in the fall of 1886, the largest, a male, weighed 2 lbs. 4 ox. The smallest, also a male, weighed 1 lb. $5\frac{3}{4}$ oz. A large female weighed 2 lbs. 3 oz. The average of 6 males was 1 lb. 10 oz.

Colour. In general, above, chestnut brown, darkest on the crown and back, becoming pale and gray on the belly and cheeks, and nearly white on the chin and throat and inner side of legs; the feet are covered with close, hard, shiny hair of silvery brown.

Freaks of colour are often seen. Melanistic, or black-coated, Muskrats are not rare; they bring a much higher price than the normal brown. White freaks or albinisms are occasionally met with; they are of no commercial value.

RACES

The following forms are recognized:

zibethica Linn., the typical form. T. l., Quebec.

pallida Mearns, a smaller, paler race, without overlying black hairs. T. l., Fort Verde, Ariz.

aquilonia Bangs, smaller than the type; blacker and with smaller hind foot. T. l., Rigolet, Hamilton Inlet, Labrador.

ripensis Bailey, a smaller race; pale, with white spot over each nostril, and a dusky chin-stripe. Size of *pallida*, with shorter tail, and darker colour. T. l., Eddy, Eddy Co., N. M.

alba Sabine, a small race; paler than the type, with shorter tail and foot, and with small molars. T. l., Cumberland House, Sask.

spatulata Osgood, a small, dark race, with spatula-shaped nasals. T. l., Lake Marsh, Yukon, Canada.

zalopha Hollister, a small form with short tail, small hind foot; redder than *spatulata*. T. l., Becharof Lake, Alaska Pen., Alaska.

osoyoosensis Lord, like *spatulata*, but larger and darker; with much larger teeth. T. l., Lake Osoyoos, B. C.

occipitalis Elliot, much like *osoyoosensis*, but paler or more reddish. T. l., Florence, Lane Co., Ore.

mergens Hollister, large and pale; much paler than *osoyoosensis;* larger and darker than *pallida*. T. l., Fallon, Churchill Co., Nev.

cinnamomina Hollister, smaller than *zibethica* or *osoyoosensis;* pale and reddish; teeth and skull small. T. l., Wakeeney, Trego Co., Kans.

macrodon Merriam, like *zibethica*, but much darker and larger; almost black; teeth much larger. T. l., Lake Drummond, Dismal Swamp, Va.

obscura Bangs, smaller than *zibethica*, darker above and less red below. T. l., Codroy, Newfoundland.

rivalicia Bangs, smaller than the type; duller and darker. T. l., Burbridge, Plaquemines Parish, La.

The last two, being completely isolated, are by some considered separate species.

RANGE

Excepting the Gray-wolf and the Red-fox, there is no North American animal on this list that has so wide a range as the Muskrat. From Altantic to Pacific, from the Gulf of Mexico to the Arctic Ocean (with one or two ever-diminishing blank areas inside this vast and comprehensive realm), it is found in abundance.

Like all successful species, it is extending its range. In California, we learn from Donald R. Dickey, of Pasadena, that the species has appeared in the San Joaquin Valley. A specimen was recently taken on the west shore of Buena Vista Lake, Kern Co.; and seems referable to the form *mergens*.[1]

Continual extensions into all the arid regions may be looked for, as irrigation opens the way. Furthermore, man is responsible for deliberate colonizations of this species of boundless possibilities.

In the *Canadian Field Naturalist* for Sept., 1925 (p. 151), are given details of the recent successful introduction of the Muskrat into Vancouver Island. The species is not indigenous on the island, but has thriven from the beginning. M. B. Jackson, chairman of the Game Conservation Board of British Columbia, has the matter in hand.

The most unlooked-for result, however, is the spread of the Muskrat in Europe; for it is contrary to all precedent for an American species to succeed in Eurasia.[2]

The main facts are as follows:

MUSKRATS IN CENTRAL EUROPE

"In 1906, Princess Colloredo-Mannsfeld imported four pairs of Muskrats [*Ondatra zibethica*] from America; and turned them loose in Dobrisch, an estate southwest of Prague, Bohemia. These animals subsequently increased in such numbers that, at present, they have spread all over Bohemia, into Upper and Lower Austria and Moravia, and also into Bavaria and Saxony, following the watercourses.

---

[1] Journ. Mamm., Feb., 1923, p. 56.

[2] See my paper on "The Evolutionary Force of a Wide Range," Journ. Mamm., Aug., 1922, pp. 167–69.

"The Muskrats have shown themselves to be very injurious, as they construct their burrows in the dams and embankments of the rivers and ponds; and thus, by undermining the banks, they endanger the whole system of waterways, subjecting the surrounding fields to the danger of floods.

"Very strict regulations have been issued, therefore, in all the countries invaded by the Muskrat, to curtail its further spread; and it is generally forbidden under heavy fines, to maintain the animals, breed them, or turn them loose. All persons directly or indirectly interested, are required to report every appearance of Muskrats to the authorities. Owing to his secretive habits of life, the Muskrat often succeeds in remaining unnoticed for a considerable period in his new haunts."[3]

Home Range

It is a common saying and ancient wisdom that without travel, one's mind is not expanded. The inference is hard on the Muskrat; and yet, regrettable to be admitted, that inference is right.

The home locality of each individual Muskrat is less than 200 yards across. He will live and thrive and be happy in a little pondy marsh even smaller; and never wish to leave it until it dries up. This gives us some gauge on the breadth of his ideas and the development of his poor little mind.

Near Carberry, is an isolated pond only 50 feet across, that has long been the sufficient home of at least one pair of these animals.

On my land in Connecticut is a lake with 2 Muskrat families at points 200 yards apart. When one family was killed, no other Rats were seen in that part of the lake, till new tenants came. All evidence went to show that these Muskrats did not go more than 100 yards from home, and rarely that.

At another point, is a pond about 50 yards long and 10 yards wide. A pair has nested in one end; and although seen daily, they are never observed at the other end.

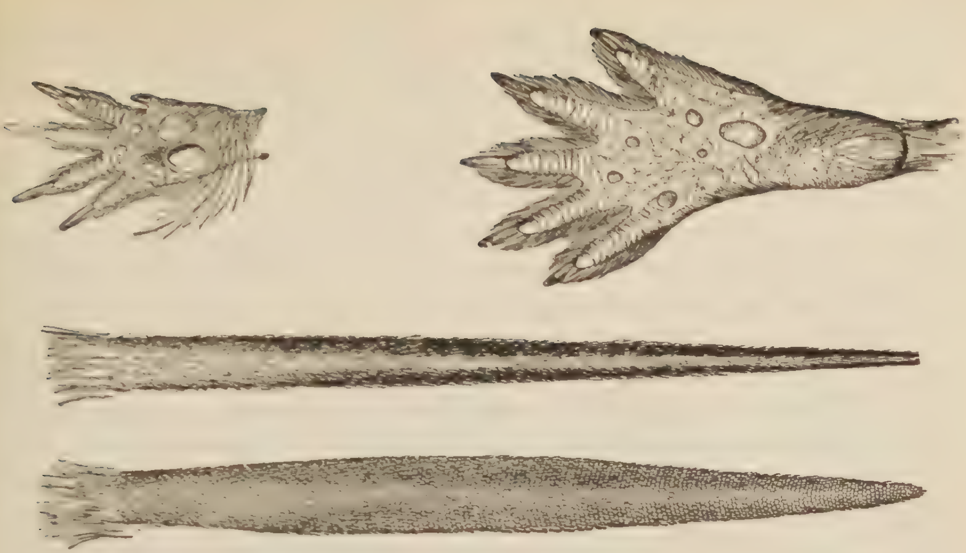
In an Iowa prairie-pond about 40 yards by 60, surrounded by dry, open country, I saw 8 good-sized rat-houses; one of them seemed to be double, it was so large. In a pond about 30 by 40 yards, I saw 3 large rat-houses. In another isolated round pond, 10 yards across and quite alone in a dry region, was one large rat-house. This was on Nov. 28, 1905.

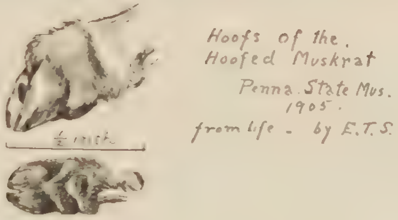
Near Washington, Minn., Nov. 30, 1905, I saw 15 large rat-houses and some smaller beginnings in a pond but 30 by 100 yards. The number of houses to the acre seemed to increase as we went northward

On the 12-acre lake on my homeland in Connecticut, in the fall of 1924,

---

[3] Theodor G. Ahrens, Journ. Mamm., Nov., 1921, p. 236.




Hoofs of the.
Hoofed Muskrat
Penna. State Mus.
1905.
from life - by E.T.S.
½ inch

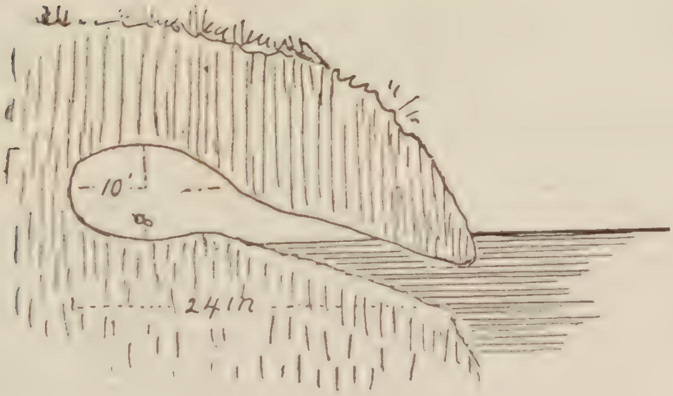


PLATE LXX.—DETAILS OF MUSKRAT ANATOMY, ETC.

The upper figures represent fore foot, hind foot, and two sides of the tail. Cuts from Mearns's *Mammals of the Mexican Boundary* supplied by the U. S. National Museum

Central figure shows the hoof of the freak Muskrat collected by Prof. H. A. Surface, of Harrisburg, Pa. The lowest figure shows the simplest style of Muskrat den. Noted at Cos Cob, Conn., 1906

I counted 23 rat-houses; besides which the high banks all around afforded desirable denning places for at least as many more Rats.

HAUNTS AND MIGRATION

There is an old Indian legend which tells that the Muskrat rendered great service to Nanabojou during the Flood. So the Sun-god said: "You may have any part of the country to live in that you please." The Muskrat took the deep blue lakes.

But next day, he came back, and said: "I made a mistake; I want the grassy banks where there is something green to eat." These were given him.

The next day, he was back to say that he was again mistaken, as the banks offered no chance to swim, and he wanted the deep water again.

Nanabojou replied: "One day you want land; the next day, water. You don't know your own mind, so I will decide. Henceforth, you shall live in the Between-land of the marsh—neither land nor water—where there is long green grass to eat, and water deep enough to swim in." And so it has been ever since.

Wherever, on this vast continent, there is slow water with rushes or weeds, we find their child, the Muskrat. And far from these, he is never found, except when seeking a new home.

This home-seeker may have been crowded out by overpopulation or by man; but most often by the drying up of his native pond.

In September, or sometimes later, an erratic migration takes place. The Muskrats then travel overland for a considerable distance—as far as a mile or two from the water; so that they are to be found in various odd places. I have seen them in outhouses, in wheatfields, and on the open prairie at such times.

"In late March," says A. W. Anthony of San Diego, "I once met a Muskrat on a sage-grown mesa, a full mile from the nearest stream, and 15 miles from the nearest water toward which he was journeying."[4]

When thus discovered, they commonly show fight, even going out of their way to attack the disturber of their peace.

SHIFTING POPULATIONS

Like all fur-bearers—probably all animals—the population of Muskrats is ceaselessly changing. Bad weather, floods, droughts, epidemics, etc., affect their aggregate numbers.

---

[4] Journ. Mamm., Feb., 1923, p. 60.

Thus, in 1907, when in the Slave River country, I met William Hays, an engineer, who told me that in 1900, the Muskrats were extremely abundant on Willow River, a branch of the Mackenzie, 18 miles below Providence. A man could stand in one place during the evening, and shoot 20 Rats with a 22 rifle in an hour. That fall, after the ice came, the river rose 4 feet, and all the Rats were drowned or driven out—mostly drowned. Next year, there were "no Rats; they have been scarce ever since; but are slowly coming up again."

J. Dewey Soper writes: "It is estimated that between 1,000 and 2,000 Muskrats inhabited the dried-up lake west of Islay [Alta.], in the pre-settlement days. This has an area of approximately one and a half square miles. Two trappers, operating between Edmonton and Vermilion, via the Vermilion lakes, in 1908, took for fall and spring 3,900 Muskrat skins. From Manville to Vermilion, on the Vermilion River, a distance of about 50 miles, one party in the old days took 2,500 skins, and I understand this was for the fall only. To-day, the majority of these places are nearly destitute."[5]

It is morally certain that Muskrats were unknown in the Imperial Valley, Calif., until some 20 years ago, when irrigation was developed. Now, what a change! Joseph Dixon, discussing the abundance of the species in that Valley to-day, sets the number as high as 200 per mile along some of the banks; and adds: "In three months, W. W. Morrison and assistant, caught 1,738 Muskrats. From the known numbers of trappers and their catch, it is conservatively estimated that 25,000 Muskrat pelts were shipped out of the Imperial Valley during the trapping season of 1919–20. It is further believed that the catch (25,000) equalled one half the total population of Muskrats."[6]

NUMBERS

In the marshy parts of Manitoba, I have often seen 100 Muskrat families in 50 acres of marsh; there may easily have been 10 Rats to the acre.

More exact light as to rate of population, is found in the following: In Delaware, Gen. Coleman Dupont has a marsh of 1,000 acres, in which they formerly trapped 4,000 Muskrats per annum. This, however, proved too heavy a drain. Now they take only 2,000 a year, which the Muskrat population stands quite well; implying, I take it, a stock of 10,000 Rats, or 10 to the acre.

---

[5] Can. Field Nat., Sept., 1921, p. 108.

[6] Journ. Mamm., Aug., 1922, p. 141.

Dr. Charles E. Johnson says: "In certain protected marsh areas, which I saw in this State [N. Y.,] I am quite certain that an estimate of as many as 10 breeding pairs to the acre, is no exaggeration."[7]

In Minnesota, with its area of about 80,000 square miles, 3,000,000 Muskrats are taken annually.[8]

In Louisiana, according to F. G. G., the 45,000 square miles yielded in 1909, some 500,000 Muskrats.[9]

In Delaware, according to the Smyrna *Times*, "the largest trapper on Bombay Hook Island is Jim Hoffecker, who has delivered 3,200 hides from his marsh."[10]

These, however, are local observations and high records. The whole of the range has been under contribution for more than 150 years, because its fur has always had a place in the markets. As early as 1822, the Hudson's Bay Company exported 150,000 Muskrat skins annually. Since then, the numbers have steadily increased; and 3,466,429 were marketed in London during 1905.

The ever-growing demand for Muskrat fur is shown in the sales records for the last 150 years. Prof. David E. Lantz[11] has found that "from 1763 to 1800 (38 years), the total number of Muskrat skins imported and sold in that [London] market was 2,831,453, an average of less than 75,000 yearly. During the 50 years from 1801 to 1850, the total was 20,571,428, or an average of 411,000 yearly. From 1851 to 1890, inclusive, the importations were 99,893,591, a yearly average of 2,500,000.

"The average London sales in recent years have been over 4,000,000 per annum, and the entire output of skins for 1900 was 5,285,000. . . .[12] The total output of 1905 . . . was over 7,000,000."

To this, Dr. Charles E. Johnson adds: "In 1919, according to John F. Mallon, Actuary, Fur Dressers' and Fur Dyers' Assoc., Inc. (in a statement dated Jan. 14, 1920), the total number of dressed Muskrat skins for the entire country was 8,643,422."[13]

According to the official published reports, the total number of Muskrat skins taken in Canada alone during the seasons 1919-20 to 1923-24, was as follows: 2,377,424; 2,915,481; 3,060,526; 3,846,161; 2,985,395. The bulk, apparently, came from the United States, where less favourable Muskrat range is offset by the much larger number of trappers.

---

[7] Muskrat in N. Y., p. 312.

[8] Fins, Feathers, and Fur, Dec., 1916, quoted in Cal. F. & G., July, 1917, p. 132.

[9] Forest & Stream, May 22, 1909, p. 815.

[10] As above, May 21, 1910, p. 812.

[11] The Muskrat, pp. 24-26.

[12] Rept. U. S. Com. Fish & Fisheries for 1902, pub. 1904, p. 285.

[13] Muskrat in N. Y., p. 207.

Add to the above total, about 1,300,000 killed for flesh, and not marketed. This would give a grand total of 10,000,000 Muskrats per annum; and, as Prof. Lantz says: "It is probable that, with adequate protection in the breeding season, from 10,000,000 to 12,000,000 pelts can be taken annually in North America, without depleting the supply."[11]

Assuming, as for other fur-bearers, 20 per cent. to be the drain that the species can stand, we have a Muskrat population of 50,000,000. I can easily believe it to be true.

The Fur

The Musquash fur is of good quality, warm, dense, and waterproof; it is on a strong skin which makes a durable leather. So that, even as Muskrat, it has always commanded a steady market. But we have lived to see great changes. The neo-fur-men have developed many and mysterious methods. Out of commonplace Muskrat, they can, by their magic, conjure up "Plucked Beaver," "Wallaby," "Velvet Coney," "Moleskin," "Sealskin," "Otter." To so many new and rare products does the innocent Ratskin lend itself, that its value has gone up twenty-fold.

These new appreciations are sufficiently reflected in the market ratings. During my young days in Western Manitoba (the early '80's) we used to get 5 cents per skin, and then had to take it out in trade. For example, 3 Muskrat skins, if prime, would buy a pound of sugar; 15 would buy a pound of tea; and 20 would buy a pound of tobacco. As late as March 26, 1904, the Winnipeg fur market quoted prime winter Muskrats, 3 cents to 12 cents; prime spring, 6 cents to 20 cents.

The average values per skin on the Canada catch for the years 1919 to 1924 were: $2.54; $1.24; $1.54; $1.32; $1.15. But during the great fur boom of 1919–20, choice skins brought as high as $5.00 and $6.00.

According to the latest official returns from Canada (and probably for all America), the aggregate catch of Muskrat pelts exceeds the total number of all other fur-bearers; and the value of the catch is, by far, the greatest on the list.

To put it in figures: For 1923–24, the total Canadian catch of Muskrats was 3,440,363; the total catch of Beaver, 169,172; the total catch of all species, 4,207,593. The total value of the Muskrat catch was $2,985,395; of the Beaver catch, $2,542,992; the total value of all furs taken in Canada that season was $15,643,817. That is, the Muskrat made about ⅘ of the number, and ⅕ of the values; the Beaver coming second in value.

---

[11] The Muskrat as Fur-bearer, p. 12.

In view of these facts, then, it is not too much to claim that the Muskrat is the most important fur-bearer in America.

The Flesh

The flesh of this animal is eaten at all times by the Indians. In the fall and the winter, it is not unpalatable—indeed, it somewhat resembles duck; but in the spring, it is so impregnated with musk as to be repellent to most persons.

When Muskrats are to be eaten, they are commonly shot; but only the trap and the spear are used when they are taken for fur.

The Biological Survey has offered a Bulletin[15] on "The Muskrat as a Fur-bearer," and as a food supply. In this, full directions are given for successful cooking of the Muskrat flesh—by frying, roasting, and stewing; concluding with a remark: "The slightly gamey flavour of Muskrats prepared by the above recipes, is liked by most persons. Should it be objectionable, it may be overcome by soaking the meat overnight in salt water."[16]

But for the unfortunate stigma conveyed by the word "Rat," it would long ago have been listed among the delicacies of the game list. In my opinion, well-cooked Muskrat is preferable to ordinary canvasback duck; that is, canvasback without the embellishments of the latest and most refined cuisine.

In the markets of Philadelphia, Wilmington, and of Baltimore the gastronomic capital of America, the carcasses of Muskrats are sold as "Marsh Rabbits."

How to Trap the Muskrat

I decline to make any statement.

A Freak Foot

The following is a remarkable case: During the fall of 1905, a trapper, Nelson Crane, living on the Oquago Creek, an affluent of the Delaware River, Pennsylvania, was surprised to see, along the margin of the river, the unmistakable track of a hoofed animal whose feet were smaller than those of the smallest African Gazelle. Each track was less than the tip of a little finger; the stride was two inches, the straddle a little over an inch. At many

---

[15] No. 869, Sept., 1917, see References.

[16] P. 11.

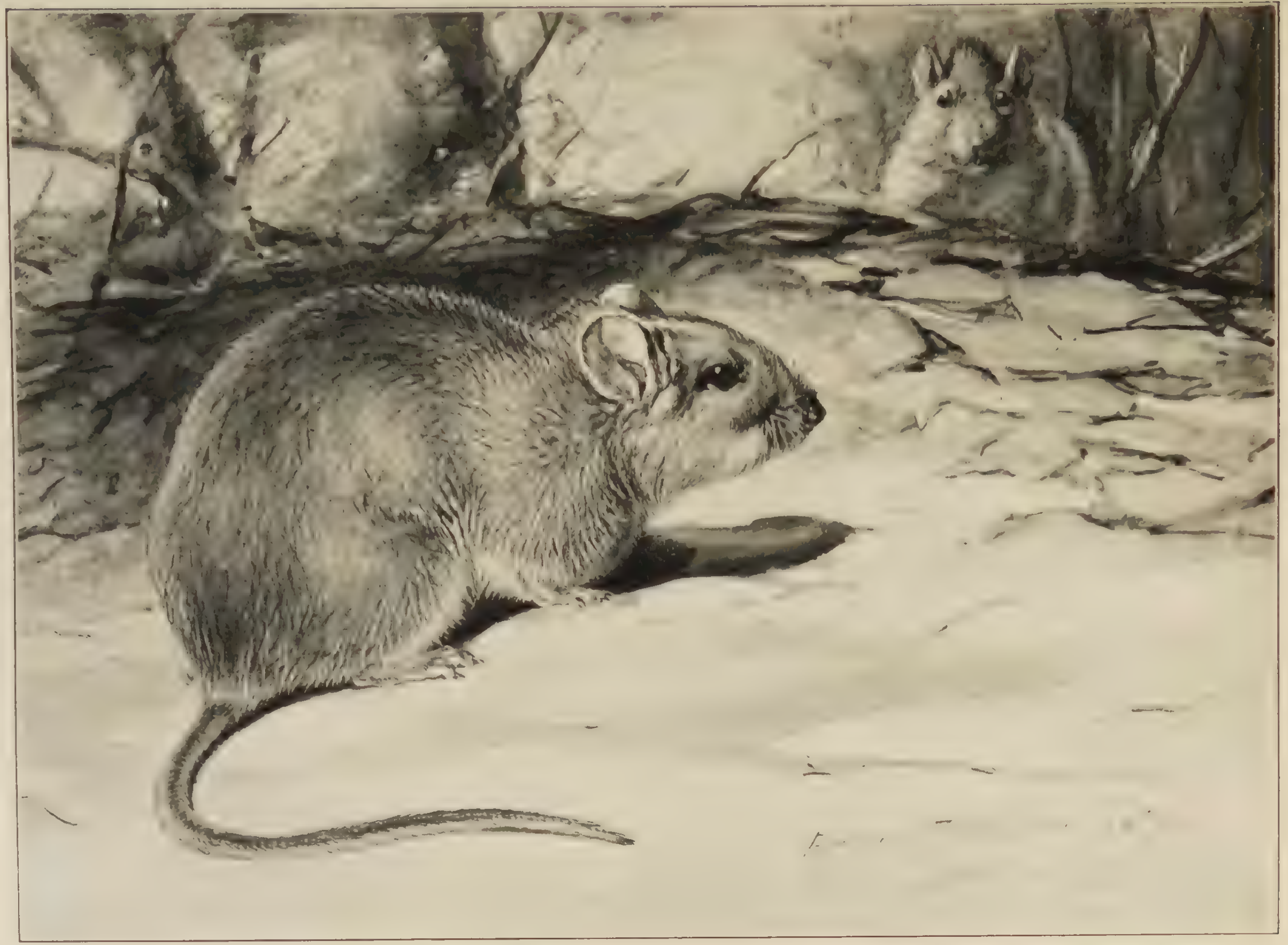


PLATE LXIV.—FLORIDA RAT

PLATE LXXVII.—THE LYNX MAKING A MISTAKE

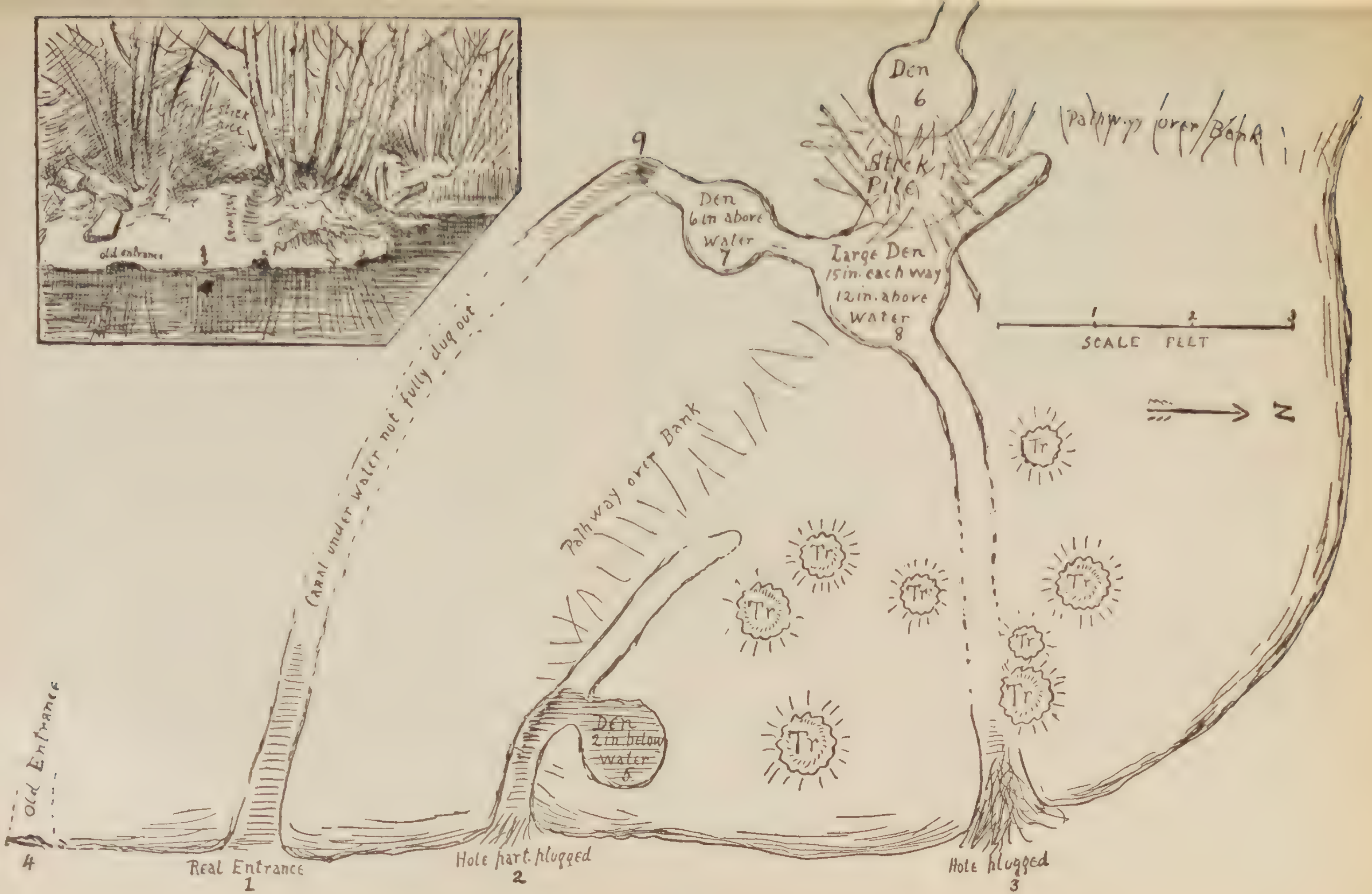


PLATE LXXI.—SKETCH AND PLAN OF A MUSKRAT DEN AT COS COB, CONN., JULY, 1905 places, very clear impressions were seen; and left not the slightest question of its being a tiny, hoofed quadruped of unknown species.

One day, on going to a trap set for Mink, Crane found the undoubted track of the "Pigmy Deer"; and in the trap, to his amazement, one of the legs of the animal with the hoofs. There was just enough of the leg to show that it was nothing more than an abnormal Muskrat, the central toes of each foot having enormously developed short claws which covered the point of the toe, and were indeed hoofs. The trapper sent the foot to the Harrisburg State Museum. Through the kindness of the curator, Prof. H. A. Surface, I have been able to examine and make the accompanying drawing of this curiosity. (Plate LXX, p. 573.)

The animal itself has never been seen.

Speed and Powers

On the land, the Muskrat is slow; a man can easily catch one. Indeed, I never knew one try to escape, if found on land. He knows that here his case is desperate; so, instead of running away, he bravely turns to fight.

But the water is his proper element; he swims and dives almost like an Otter. I have often run along on the thin, clear ice, over a Muskrat that was swimming just below, and found he was going, for the spurt, at which I should call 3 miles an hour. But observations made while walking parallel with a swimming Muskrat, lead me to say that his ordinary rate is not above a mile an hour.

In swimming, the hind feet principally are used, but the tail assists; although it is quite common to see a Muskrat swim with his tail curved clear out of the water.

Much of the Muskrat's hold on life is derived from his diving power, for he can outswim and outdive a Mink. He can swim fifty yards without coming up for breath.

E. P. Robinson, the Packerville, Conn., correspondent of *Forest & Stream*, writes concerning a naturalist friend: "While looking carefully for suckers, he saw a Muskrat at the bottom, apparently eating something. He watched, and presently the Rat turned his nose upward, and expelled the air from his lungs in small bubbles, which rose to the ice through 2 or 3 feet of water, and formed a large bubble, which the Rat came to and rebreathed, and proceeded to resume his feeding. He watched him repeat the performance several times, always letting the air rise through the water."[17]

---

[17] Forest & Stream, April 22, 1911, p. 612.

In one particular activity, the Muskrat is at the bottom of the scale—he cannot climb a tree. He cannot climb anything but a low mound or bank. He is no better off than a Mole or tortoise in this respect. A 2-foot fence, unless he can go under or around, is an impassable barrier to him.

PLAY-GAME

Every animal treated in these Lives has a song, a dance, and a play-game. This is a perfectly safe, though unproved statement. I expect, in time, an affirmative, detailed answer to each and every assertion concerning each and every animal in the above connection.

The Muskrat is not an intellectual wonder; one might even be justified in applying adjectives that sounded harsh, when speaking of his wits. Yet I was not surprised to find the following, also from the pen of the Packerville naturalist. He was cultivating the acquaintance of certain Muskrats, and doing it by the well-known trick of softly talking and singing to them—"making medicine" with his mouth, as the Indian would say. He continues:

"On two or three occasions, after we became on friendly terms, one of the young ones, possibly to repay me for the music, gave an acrobatic performance which was entirely new to me. After lying on the water quite still for a time, he would begin to sink lower, and turn around and around like a Dog chasing his tail, gradually sinking lower and lower, and ending the feat wholly under the surface, which seemed greatly agitated."[18]

FOOD

By all the rules of dentition, the Muskrat should be strictly a vegetarian. As far as is convenient and agreeable, the Beaver's little brother lives up to this understanding, and the food of the species is chiefly vegetable matter. The bleached ends of long reeds, lilies, stalks, and roots of flags are staples; but nearly every green thing in the marsh is a bag of vitamines for him. He is impelled to one or other kind of food by the urge of his body, which, in the blissful safety of its ignorance, demands this or that peculiar herb to be stressed, to the forefending thereby of a thousand ailments, of which he never has a clear consciousness, much less a name. (Humans, take a hint from this, and cultivate natural appetites.)

Sir John Richardson, writing at Churchill River (103° W. long.), in 1848, says[19] of one Muskrat food: "The *Acorus calamus* is another of the indigenous plants that enter into the native pharmacopœia; and is used as a remedy in colic. About the size of a small pea of the root, dried before the fire or in the sun, is a dose for an adult; and the pain is said to be removed soon after it is masticated and swallowed. When administered to children, the root is rasped, and the filings swallowed in a glass of water, or of weak tea with sugar. A drop of the juice of the recent root is dropped into inflamed eyes, and the remedy is said to be an effectual, though a painful one. I have never seen it tried. The Cree name for the plant is *watchuske mitsu in* or 'that which the Muskrat eats.'"

---

[18] Forest & Stream, April 22, 1911, p. 612.

[19] Arctic Searching Expedition, 1851, I, pp. 82–83.

There is not the least doubt, furthermore, that the Muskrat will eat clams, fish, insects, and even young birds, when it can catch them *in* the water.

As a Clam-eater

There is a backwoods saying: "A pile of empty clam-shells by a hole means a fur cap inside"; and there is much evidence that clams are a favourite food of the Muskrat. He is adroit in his ways of getting at the clam. He can, indeed, cut the hinge and force it open; but, when not pressed for time, he follows a simpler plan. He lets the clam die on the dry bank; then it opens itself.

J. Alden Loring, in a detailed article, emphasizes the clamophagy of the Muskrat. "Along the banks of the beautiful Susquehanna River," he says, "I have seen bushels of clam-shells heaped under a stone, a log, or the roots of a tree, by Muskrats, after they had feasted on the contents of the shells.

"In one place, while canoeing down the river from Cooperstown, I passed a strip about 3 miles long, that was particularly thick with clam-shells. While gliding silently along down to shore, I surprised a Muskrat on the bank. After it had rushed into the water, I landed and trailed it in the soft mud to a spot a few feet from the shore, where it had stuck a fresh clam in the mud to be opened by the sun.

"This accounts for the large number of shells that are found unbroken in the heaps."[20]

Similar testimony is received from many other observers. R. E. Coker, of the U. S. Bureau of Fisheries, says: "The most important element of the winter food of the Muskrat . . . is the fresh water mussels or Unionidæ. . . . Sept. 24, 1907, one of these piles on Long Point was examined. It was off-shore several feet, and in water 18 inches deep. About one half of the shells were examined critically, and counted. There were 532 shells representing four species.

"During the fall, these operations are probably confined to mussels which they find in shallow water near shore. In winter, however, when ice-cracks form, and extend well across the lake, the Muskrats go far out on the ice, dive through the cracks, and bring up mussels which they eat, sitting on the ice. At such times, they get mussels at considerable distances from shore. In the first days of Jan., 1905, a broad crack formed in the ice from Long Point to the Norris boathouse. On Jan. 4, a Muskrat was seen at the edge of this crack about 1,000 feet from shore, eating mussels. It would dive through the crack; and, after a little while, reappear with a mussel. Sometimes, it dived five and six times before securing one. It would then sit up on its haunches, holding the mussel in its paws; and, by much clawing and chewing, finally succeed in opening the shell, and removing the meat, which it usually licked out quite clean. In some cases, the Muskrat failed to get the shell open."[21]

---

[20] Recreation, Nov., 1900, p. 383.

From Winnipeg, George H. Measham writes me: "Whether clams are part of their customary bill of fare during the winter, I do not know; but they have regular feasts of them in the spring, and consume astonishing numbers of them. The Muskrat will pick on a suitable place on the bank of the stream for his dining table, often a broad, flat stone; and then proceed to dig out of the river bottom a fine, fat clam. He carries it to this chosen spot, speedily opens the shell, and devours the contents. Opening clams is not easy, unless you know how; and the Rat knows how. He bites through the leathery ligament that joins the shells together at the back; this done, the clam is his meat."

Fish and Flesh

The steps are easy from clams to other animal food found in water. The testimony is in line:

R. E. Coker in the article already cited, says: "Muskrats also feed to a considerable extent on fish, crawfish, and frogs. We have, on more than one occasion, found partly devoured fish at their feeding stations, and remains of fish, frogs, and crustaceans in their kitchen-middens. We have never seen a Muskrat catch a live fish, but have no doubt they do so. They certainly pick up freshly dead fish which they chance to find."

To this, a still more sporty touch is given by Edward R. Warren, the Colorado naturalist. He says he has seen a Muskrat "chase and catch a water-dog or lizard. Four years ago, a friend and I were driving by Nichols Lake, near this place; and we noticed some animal swimming under water, chasing another animal. I pulled up the Horse at the edge of the lake. The water was calm, and the sun shining, so we could see everything clearly.

---

[21] Forest & Stream, April 1, 1911, p. 493.

My first thought was that it was a Mink trying to catch a trout; but I soon saw what the pursued was. The water-dog twisted and turned quickly, but his enemy was as quick as he. Finally, when the two were about 3 feet apart, and 25 or 30 feet from shore, the pursuer made a sudden dash, caught the water-dog, and rose to the surface. Then I saw the pursuer was a Muskrat. It swam partly out of the water, so I could identify it beyond doubt. The Rat swam off with its prey."[22]

Testimony of this kind could be piled up in volumes; but an interesting new turn is given to it in the following by Avon Woods. He and a friend were out ducking in Nov., 1899. They noticed the splashing of Muskrats. His friend said: "Watch me call out that Rat." Woods proceeds:

"My friend was an adept at imitating the quack of a duck with his own voice. When he reached a place that suited him, he remained quiet for some minutes. Then he raised one foot to the surface, and splashed the water gently, uttering a most natural imitation of a female mallard, which reverberated over the water in the deathlike stillness.

"This seemed to me a strange way of coaxing out a Muskrat; and I thought my friend was jesting, or had caught sight of a flock of ducks, and was trying to decoy them in. But I was mistaken; for, in less than half a minute, as I watched the water in the reflection of the moon, I saw a fine, large Muskrat swimming directly toward him, turning its head from right to left, as if looking for something. My friend stood perfectly still until the Rat came within 8 or 10 feet of him, when it ran its head squarely into a charge of number 5 shot.

"My friend brought the Rat to shore; and, as he threw him down on the snow, he said, 'This Rat has evidently been in the habit of catching and eating wounded ducks, and perhaps of pulling down those that were not wounded, and drowning them.'"[23]

It is not surprising, then, that wise old-timers like Maniy Hardy often use meat baits when trapping the Muskrat. The following is from his record: "We caught a Muskrat in a log trap with meat, quite a way back from the water, and a Rabbit (Hare) in a log trap baited with fish."[24]

STORAGE

Although not usually credited with storing up food for winter, the Muskrats do so at times. All through the summer, from at least the first of June, they may be seen carrying great bundles of green stuff into their dens. If intended for bedding, it seems to show very poor judgment on the part of the Rats; but it ends well, for they commonly eat these piles when they have need of them. This is, indeed, one kind of storage.

---

[22] Recreation, Nov., 1900, p. 383.

[23] As above, Dec., 1899, p. 439.

[24] Forest & Stream, May 28, 1910, p. 850.

The species, however, is known to carry out the idea on a much higher plane, as shown in the following by Dr. Charles A. Eastman:[25] "When our people [Sioux] were gathering the wild rice [in Minnesota], they always watched for another plant that grows in the muddy bottom of lakes and ponds. It is a white bulb about the size of an ordinary onion. This is stored away by the Muskrats in their houses by the waterside, and there is often a bushel or more of the *psinchinchah* to be found within. It seems as if everybody were good to the wild Indian, at least, we thought so then." Evidently, this was the *wapat*, or duck potato, a species of *sagittaria*.

The Muskrat does not usually lay up a supply of food in the sense that the Beaver does; yet the rat-raft and rat-house both are closely connected with the quest of food. In the winter, it is obvious that the house is much eaten away from the inside. While the roof is frozen, this makes no difference; but in the spring, when the frost gives, the top of the enlarged chamber is apt to fall in.

The filling up and digging is now resumed; for in many cases, the rat-house is the home of the young brood; that is, when there are no high banks near by to afford opportunities for burrows.

A Muskrat Silo

A much more complete and satisfactory mode of storage is announced by Thomas D. Carter, of Saskatchewan. He describes the four tunnels, each 8 inches wide and 12 feet long, that branched from the Muskrat's main tunnel in a dry bank; then says of these:

"These tunnels were packed with tender bullrush roots, sedges, mints, young grass, and reeds. The bulk of the store was white and crisp, and very tightly packed. Each of these tunnels was plugged with clay at the junction with the main tunnel, to exclude air. . . .

"The young Muskrats aided the parents by carrying earth from the tunnel, and also in bringing in the food store." [26]

Social Calls and Usage

The Muskrat is more sociable than the Rabbit, but less so than the Beaver. Several will join their efforts to produce the rat-house or lodge; and they are always careful to announce to each other the discovery of danger by the loud alarm splash, that the uninitiated think could be made by nothing less than a Moose jumping into the water. I have several times heard of Muskrats uniting also to fight some common enemy, but never saw one of these affairs.

---

[25] Indian Boyhood, 1902, pp. 239-40.

[26] Can. Field Nat., Dec., 1922, p. 176.

Besides the danger splash already noted, this animal can use its voice as a means of signalling. A low squeaking, made by sucking the back of one's hand, gives a passable imitation of the Muskrat's friendly call to its mate, and is sometimes used by the Indians to decoy the swimmer within shot. At times, Muskrats squeal very loudly, and snarl among themselves.

Besides these sounds, the anal glands also serve as a method of communication. They secrete the well-known musky smell; this is left with the dung at the various landing places, and I doubt not answers as a sort of crude news office, or club register, as described in the Gray-Wolf Life (Vol. I, p. 286). Each Rat, on arriving, can tell by the smell, whether or not any of his acquaintances have called there recently.

A Little Brother to the Beaver

The Beaver's little brother has paralleled the Beaver's activities in every department but one—namely, the Muskrat does not make a dam. A home he makes, and canals, jetties, tunnels, rat-rafts, eating huts, food stores, mud or dung-pie signals; but, so far as I know, not the remotest approach to a dam that is meant to hold and deepen the water.

The Bank-den

The bank-den is quite as important as the rat-house; and in regions where marshes or shallow waters are scarce, is the creature's home. Very clear-cut plans are followed in making this.

When the water near the shore is shallow, the Muskrat digs a canal from the deeper water along the bottom. This is like a railway cutting, open at the top until the rise of the ground makes it easier for the Muskrat to take the plunge—that is, to carry the canal on as a tunnel; after which, it ascends obliquely to a chamber above the water level near the surface.

The evolution of this canal is suggested in these notes from my journal. In late May, at Cos Cob, Conn., John Crawford surprised a Muskrat in the small pond while away from its hole in the bank. He stood over the hole; and, though the water was but 6 inches deep at the time, it plunged into the mud and leaves at the bottom; and by tunnelling in that, stirred up such a cloud that it escaped unseen into the hole. This I also saw the next day. I think its real object in getting into the mud was to swim as deep as possible, but it was at the same time beginning a canal.

The diagram in Plate LXXI (p. 579) represents one of these that I examined at Cos Cob, in July, 1905. It was under a clump of young ash trees, and presents all the usual characteristics of the bank-den. Nos. 2 and 3 were holes at water level. They were plugged up with grass and sticks when exposed by the water lowering. No. 1, the real entrance, was deep under water, and was made later; No. 5 was a den with about 2 inches of water in it; No. 6, a small den not connected with the others; No. 7, a small den at a lower level than the main den; at No. 9 was a plunge hole from the den into deep water. No. 8 was the main den, nearly round, 15 inches each way, smoothed with great labour in gnawing off thick roots. It was very near the surface, and had a ventilator under the stick pile, as also had No. 6. The pathways were evidently made by the Muskrats in carrying up these sticks.

The main den had quantities of green grass and stalks in the corners; among these, jewel-weed was prominent. This was fresh-cut, and may have been either food or bedding—probably both.

This den illustrates the style of all those I have examined on banks. They have one main entrance under water; sometimes other smaller entrances. The tunnel leads up to a commodious den, which is open to the air at one small place, and covered outside with a pile of sticks and grass.

The main features of this agree perfectly with those of the nest made in a rat-house. The stick pile over the roof shows how easily one grades into the other.

There was no dung anywhere in the dens; all was sweet and clean.

Tunnels

Usually the tunnel is merely the approach to the bank-den; but it also furnishes a deep-water escape, as well as a highway in shallow waters that may freeze to the bottom.

Thomas D. Carter, of Saskatchewan, furnishes some interesting observations on the tunnels. In August, a family of 2 old ones and 4 half-grown young Muskrats began in a small pond but 2 feet deep. By September, they had made a trench 107 feet long and about 14 inches wide. It ended in a den that was under a willow, 30 feet from the pond, and which measured 14 inches high and 9 inches wide.

In early October, 4 other tunnels above water line were branched from the main tunnel; these were each about 12 feet long, and 8 inches wide. They were crammed with food in storage, as already noted.[27]

---

[27] Can. Field Nat., Dec., 1922, p. 176.

The Rat-lodge

The rat-lodge or house is the most obvious announcement of all that there be Muskrats in this place. In Manitoba, where there are very large marshes with low banks, the rat-houses are conspicuous features of the landscape; and important to many species of bird, especially ducks, which find them convenient nesting places.

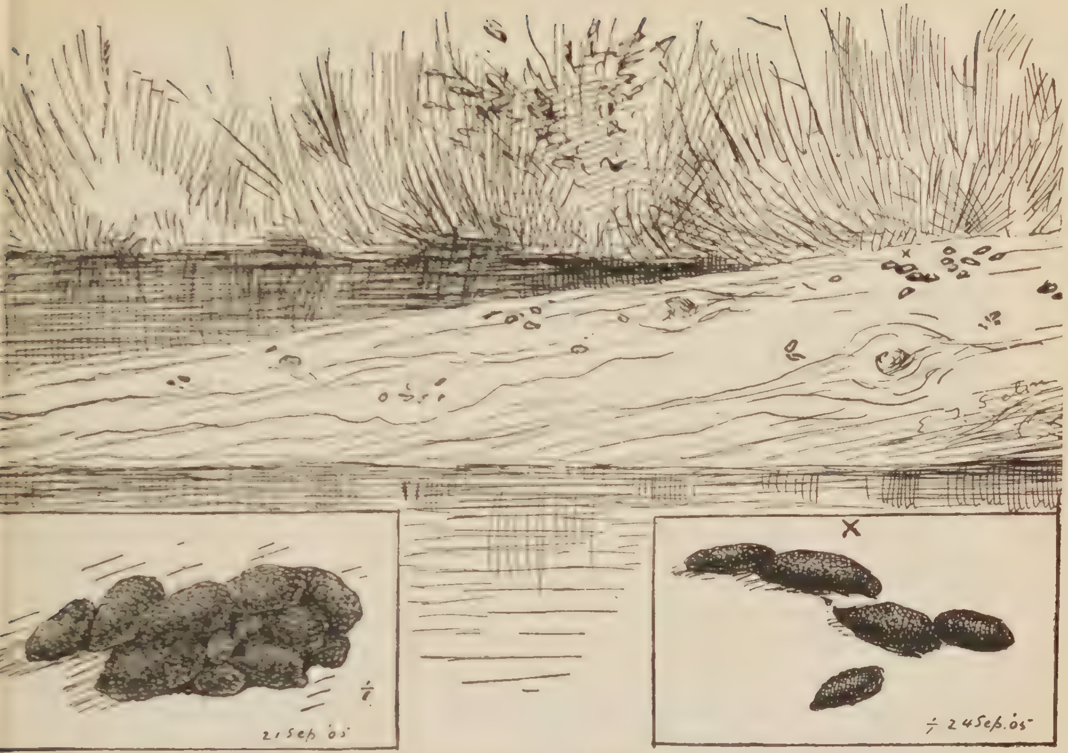
The Little Beaver begins in July to get ready for the winter, either by repairing the old home, or founding a new one. George H. Measham, of Woonona, Man., says he has known a pair to keep the same site for years.

When a new nest is to be made, they select a place in the weeds or rushes, where there is about two feet of water; and begin to drag to one spot the vegetation and mud for 10 feet around. In this way, a little island of rubbish is gradually piled up, and the water around is deepened and cleared of rushes, etc. As the island rises above the water level, less mud and more reeds are used—this is probably unintentional, as the reeds are easier to carry than mud. Now it is made a little wider, and becomes like a low haycock on a small base of mud and trash. As soon as it is a few inches above water, the builder begins to dig a tunnel under the level through the rushes on to the surface of the mud island and into the thin haycock.

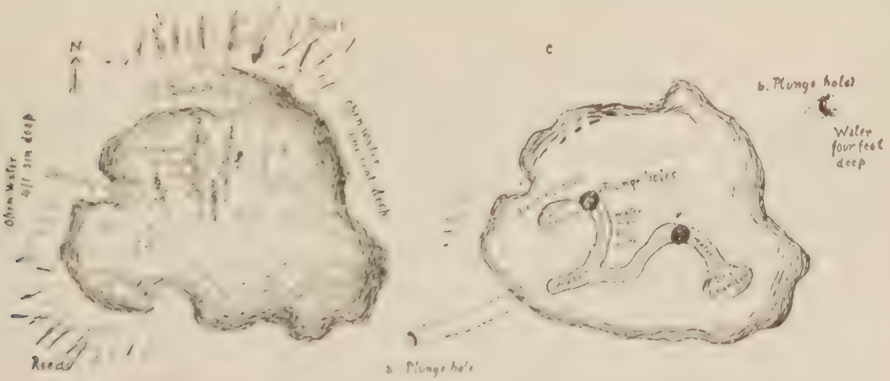
This now answers for a house, although the roof is so open that the Muskrat can see out. But the process of building goes on; each day, a few more bundles of reeds are dragged on to the pile. It grows, until, by August, it is perhaps 3 or 4 feet high; but the mass of stuff piling in, keeps crushing down the roof of the centre chamber and its gallery. The builders offset this by tearing off the encroaching ceiling, as it gets too low. In time, the subsidence ceases, the floor of the chamber is now covered with the reeds shredded in heightening the vault. The chamber is enlarged, additional entrances are made, the channel to each is deepened, and the Muskrat's house, after a slow growth during perhaps four months, is ready for winter.

I cannot say that I have followed one house through all these stages, but I have seen nests so obviously presenting each, that I consider the process demonstrated.

The ordinary house has but one chamber, but I have seen examples with more, doubtless the product of two families uniting their efforts, although each family lives by itself, having separate rooms and doorways. In Sept., 1904, I examined a large rat-house on Lake Winnipegosis, and made the accompanying diagrams (Plate LXXII, p. 589). This house was probably the joint home of two families.



Log that was a favourite landing place and news-depot of the Muskrats on a small stream 40 miles east of Kippewa, Que. With illustrations of their scatology (natural size)



A large rat-house sketched at Lake Winnipegosis in Sept., 1904.
As seen from above, and in plan

PLATE LXXII.—DETAILS OF MUSKRAT HOUSE, AND SCATOLOGY

The lodges are resting places and sleeping places, as well as, in some cases, the nurseries for the young. They are truly the homes of these animals.

The Rat-raft

Each of these large houses is surrounded by a number of rat-rafts which are like outlying fortresses of the great central camp; these are merely floating bunches of reeds, with anchorage of a few growing stalks. Their first purpose seems to be furnishing the members with landing places where they can feed comfortably. But when the ice forms, they answer a new need—they afford breathing places; for the reed raft makes it easy to keep the ice open there, and also conceals the Muskrat that is using the place.

In the winter, if the occupants be frightened out of the big citadel, they will usually be found in a few minutes scattered at the various breathing rat-holes.

In very deep water, we find a type of nest that is both house and raft. Its foundation, instead of being a mud island, is a floating mass of reeds. It answers well for the fall and winter, but usually becomes water-logged and sinks from sight in the spring.

The inborn home feeling that the Muskrat has for its raft—that is, its house beginning—is shown in this incident. During my early days on the Souris Plains (May 9, 1882), I fired at a Muskrat sitting on a large raft. It dived off into the water, but returned to clamber on to the floating reeds. I walked gently near, then waded out to find it was the same Muskrat – stone dead. It had come back to its raft to die.

Eating-huts

A higher development of these outlying posts is thus described by Dr. John Rae:[28] "The house-building habits of the Muskrat, in nearly every part of British North America, are well known; but there is one plan to which it sometimes resorts under certain circumstances, which appears to show great intelligence in enabling it to get its food more readily. The Muskrat, when about to build its house, selects a pond or swamp of good, pure water, on the bottom of which grow the plants which constitute its winter supply of food.

"If the pond or swamp is of considerable extent, and the house a large one containing many Rats, they, when the water begins to freeze in early winter, keep several holes open in the ice in different directions, and at a distance from the house; and build a little hut of mud and weeds (just large enough to hold one Rat comfortably) over each hole, which—especially when covered with snow—prevents it freezing up. These huts enable the Rats to extend their feeding-ground to all parts of the pond, which could not be reached at all, or with difficulty, from the house if they had to swim home every time with a mouthful of food to eat it. With these little shelters, they are saved a great amount of labour, and are enabled to reach all the food in the pond.

---

[28] Birds & Mamm., H. B. Co., Linn. Soc. Journ. Zool., XX, Pt. X, 1888, pp. 142–43.

"I remember, when on a snowshoe journey, one of my men went very quietly up to one of these miniature mud-huts, and knocked it over with his axe, disclosing a live Rat with some of the food it had been eating. The practice of building these little eating-huts is by no means common, and does not seem to be resorted to when the pond is of moderate dimensions, and all parts of it can be reached from the house without difficulty."

JETTIES

Muskrats frequently make jetties or landing places. These are little banks of mud along the marshy shore, a few inches above the water. From the shallows near by, the animal gathers mud and weeds to make the jetty; this also serves to deepen and clear the water, so that the owner can plunge in to safety. Besides those constructed by themselves, the Rats select and use readymade landing places, such as roots and stones by the water's edge.

They commonly leave their dung on these jetties. This marks them clearly, and probably serves as a record, as already noted (See Plate LXXII, p. 589).

In voiding its dung, the animal prefers to have its body dry and its tail in the water. One which I kept in captivity, was so particular about this, that it invariably turned its tail-end into the little water trough, keeping that in a very unfragrant condition, although the water was changed more than once each day. The origin of this custom was no doubt in the necessity for keeping the house clean. This they could be sure of doing if at each voidance, each Muskrat took the trouble to drop its tail over the threshold into the canal, which thus formed at once waterway, moat, and trunk-sewer for the inhabitants.

HAULING DOCKS

In every pond frequented by Muskrats will be found the hauling docks, where they bring bundles of sedge, etc., from the deep water to be eaten at leisure. These docks—or rather the bundles of herbage piled on them—are a conspicuous notice to the wood-wise that here are Muskrats to be found and t * * * * d, if one is so disposed.

The Foes of Wah-jusk

I had always supposed that Wah-jusk of the Moated Mounds was remarkably free from parasites. I knew, as set forth in "Life Histories," that a sort of fur-louse was found on this species, as on every creature that wears fur; but considered it unimportant.

From Dr. C. E. Johnson's monograph on the Muskrat, I was pained to learn that this simple-minded, stout-hearted dweller in the sloughs, has an awful lot of troubles of his own. Dr. Johnson says: "The Muskrat is the host for a considerable number of parasitic worms belonging to the so-called flat-worm (*Platyhelminthes*) and the round-worm (*Nemathelminthes*) groups. . . .

"A suggestion as to the frequency of infestation among the Muskrats is found in the following statement by [F. D.] Barker:[29] 'In 42 Muskrats, 881 parasites were found. No parasites were found in 4 Muskrats; 3 harboured *cestodes*, *trematodes*, and *nematodes;* and 3 harboured a single species of *trematodes*.' . . .

"[B. W.] Evermann and [H. W.] Clark remark[30] that the Muskrat 'has long been suspected' of being the intermediate host of certain parasites which induce pearl formation on freshwater mussels."[31]

All of this was terribly disappointing, and yet exactly in the line of what I should have expected. We have seen that Wah-jusk himself is parasitic on the Beaver; and by Oliver Goldsmith we are assured that

"Big fleas have little fleas
Upon their backs to bite 'em;
Little fleas have lesser fleas,
And so ad infinitum."

Why, then, should the Haycock-builder of the marshes escape the common fate of flesh?

He does not. And the list of his parasites, big and little, increases as we proceed.

Besides these creeping, crawling, or microscopic little pests, he has a host of the big, blustering kind. In the air, hawks, owls; on the land, Weasels,

---

[29] Parasites of the Muskrat, Science, N. S., 1915, p. 570.

[30] Lake Maxinkuckee: A Physical and Biological Survey, Indiana Dept. of Conservation, 1920, p. 467.

[31] Muskrat in N. Y., pp. 293–94.

Otters, Foxes, Wolves, and many others, consider him their lawful prey. In the water the pike and pickerel take him at a disadvantage.

But the worst of his animal foes is the Mink. This water-weasel abounds wherever the Muskrat does. It frequents the same places, it is aquatic, and can follow the Muskrat into his house, no matter how long or how crooked is the underwater trail to the door.

E. W. Deming, the animal-painter, tells me that when he lived on the Green River of Illinois in the '80's, he spent much time each winter catching Mink and Muskrat. He became familiar with their habits, and learned that the former feeds regularly on the latter. He once dug out a Mink, and found within its den the remains of 10 Muskrats. Apparently, the Rat has but one advantage, and that is he can *out-dive* the Mink. He is, moreover, a desperate fighter; when at bay, he never surrenders; and, as we shall see, a strong, old Muskrat may even defeat a small Mink in one of the narrow underwater ways, or other special circumstance.

There is yet another, and far more dangerous foe; the one dire and dreaded enemy of the species—that is, a severe winter, following a dry fall. The ponds are then so shallow that they freeze to the bottom, the Rats are either forced out to be at a helpless disadvantage on the snow among birds and beasts of prey or are sealed in so that they prey on each other.

Bellalise, my Indian guide on the Athabaska, told me that such a calamity took place in his trapping country in 1904. Next spring, he found 1, 2, up to 10, and in one case, 15 Muskrats, dead in the houses. They were exceedingly scarce in 1907; I saw not half a dozen during 6 months in their country, but they were slowly recovering, as so often before.

The following, by my boyhood idol—Captain Mayne Reid—illustrates the danger of a freeze-in that Muskrats face in a hard winter, if they do not bestir themselves to keep their doorways open. In three houses, the hunters found the occupants alive and well, but "on opening a fourth," he says, "a singular scene met our eyes. There was but one Muskrat alive, and that one seemed to be nearly famished to death. Its body was wasted to mere 'skin and bone', and the animal had evidently been a long time without food. Beside him, lay the naked skeletons of several small animals that I at once saw were those of the Muskrat. A glance at the bottom of the nest explained all. The hole, which in the other houses, had passed through the ice, and which we found quite open, in this one was frozen up. The animals had neglected keeping it open, until the ice had got too thick for them to break through; and then, impelled by the cravings of hunger, they had preyed upon each other, until only one, the strongest, survived!

"I found, upon counting the skeletons, that no less than 11 had tenanted this ice-bound prison."[32]

Such visitations have been periodic in the great Northland of the Muskrat range. When widespread, as sometimes happens, they amount almost to a wipe-out. It takes many years for the species to recover from such a terrible experience.

A Desperate Fighter

The fame of the Muskrat as a fighter has spread far and wide, and with abundant reason.

I once knew a migrant, militant, and malignant Muskrat hold three Horses and a mower at bay, when the field of grain was all cut except the short central swath in which the wanderer had taken refuge.

On another occasion, in Oct., 1883, while travelling over the prairies with Oxen, they swerved aside from the trail, and I caught a glimpse of something leaping at the nose of the near Ox. I jumped from the wagon, the Cattle ran away, leaving me to face—a big Muskrat. It had disputed the trail with the Oxen, and now came straight at me. Leaping for my leg, it fixed its teeth in my trousers, and held on till it was killed.

Again, at Carberry, Sept. 5, 1892, George Scollan brought me a Muskrat that was on the trail leading into Kennedy's Plain. It had claimed the right of way from him, and believed that right was might.

Another of these fighting adventures is reported by Dr. Fred J. Cadham, of Winnipeg. In Oct., 1903, while driving on the open prairie 7 miles west of the city, he saw a Muskrat travelling. He jumped out and gave chase, but it turned at once to fight him, and fought till killed.

Yet another from Germantown, Pa., is thus described by Arthur C. Emlen: "In the blizzard of 1899, a boy I know had a curious adventure with a Muskrat. He was coming home late one night, when he saw some dark object run across the lane in front of him; before he knew it, the Muskrat ran up his leg. No sooner was it thrown off than it started up the other leg. After quite a fight, the boy managed to kill the Muskrat with his umbrella. I saw both the Rat and the umbrella afterward; there was not much left of either. The strange part of this story is that it took place on a hill not very near any Muskrat haunts; so that the boy could not have been trespassing on the Muskrat's ground."[33]

Bellalise tells me that twice has he been attacked by Muskrats; in each

---

[32] The Hunters' Feast, about 1840, pp. 86–87.

[33] Letter, Oct. 7, 1900.

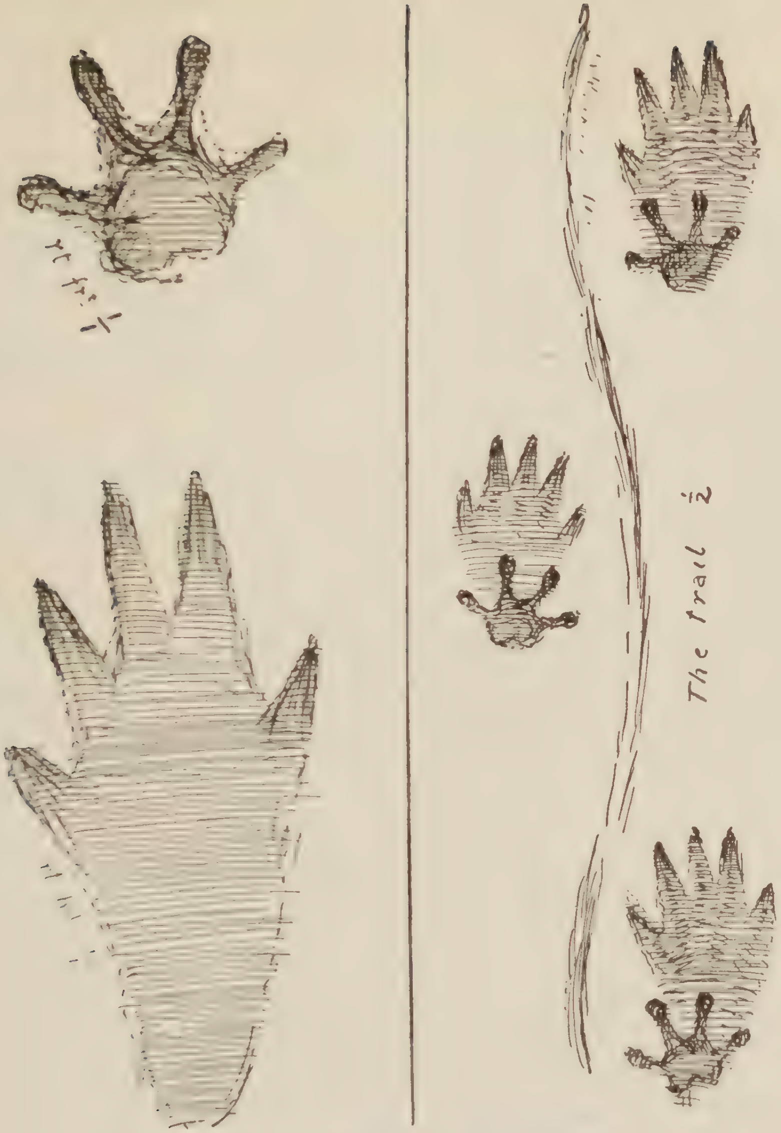


PLATE LXXIII.—TRACKS OF MUSKRAT

Those on left are fore and hind prints, life size. Those on right show the series as in the trail with the tail mark, half life size case, he came on the Rats in an open place where there was no water, and no hole or cover. They could not get away, so the Rats went for him.

B. E. Ross, a merchant of Albert Lea, Minn., writes:[34] "On my way home from the store one moonlight night not long ago, my attention was attracted by a small animal crossing the street just ahead of me. . . .

"Soon he jumped upon the walk, and stopped in front of and facing me. I now saw it was a large Muskrat, and his attitude appeared much like a challenge. Of course, I could not take that, and began hostilities at once.

"I ran straight at him, and kicked with all my strength, striking him squarely, and lifting him about 30 feet. He lay stunned for a moment, but soon struggled to his feet. Much to my surprise, he came back again; and, on my starting in his direction, ran straight toward me. I began kicking again, but found he was still very much alive.

"He jumped and dodged so rapidly it was impossible for me to land on him again. Although fairly nimble on foot, I could not keep track of him, and he finally got hold of my leg, setting his teeth into it a great deal farther than was comfortable. Finally, I killed him with a club."

Most naturalists can contribute instances of the Muskrat's ferocity; but in none that have come under my notice, was the animal in the water. In each case, it was surprised on land; and, finding itself at a desperate disadvantage, it manifested the courage of desperation.

Since the above was written, O. J. Murie has sent notes of a remarkable exception. One spring, his brother "was canoeing up the Red River [Minn.], with a companion when they came on two Muskrats on the trunk of a tree which was so bent that it was flush with the water. One Muskrat dived into the river, but the other remained and seemed disposed to resent intrusion of strangers, facing the canoe and baring his teeth. My brother reached out with the paddle, and the Muskrat seized it and fought it. Then my brother got out on some limbs, approached the animal, and managed to seize him by the tail. The Muskrat was later released, whereupon he swam around the canoe for a time, apparently in no hurry, and he could easily have been caught again. . . . This incident, it seems to me, indicates that the Muskrat will fight even if a way of escape is at hand."[35]

Fighting for Mates

When an animal is a "natural-born scrapper," it is to be expected that his fiercest demonstrations will occur in the mating season. Among the Muskrat males, at this time, desperate fights take place, if their loud snarling, splashing, and squealing at night are evidences. In these battles, the combatants' tails are often mangled—or, according to some trappers, even cut off.

---

[34] Recreation, March, 1899, p. 198.

[35] Personal letter, Feb. 24, 1927.

W. Manly Hardy, of Brewer, Me., writes: "In the spring of the year . . . fully a fifth part of a catch . . . will show the marks of night-time squabbles and bog-land brawls. . . .

"I have taken them with a single bite $3\frac{1}{2}$ inches in length, and often so cut up as to be practically worthless for sale; but I remember none which showed such injuries as this one taken this year." He then describes the battered old warrior, as follows: "Besides having his head laid wide open on both sides—a great gash on the neck—others on the shoulders, and two very deep cuts on the hips, he was so bitten on the underparts that I could and did look directly into one of the wounds, and see his liver lying bare and exposed. Below that, and from another wound in the abdomen, there trailed a loop of the intestine some 3 or 4 inches in length. From another wound corresponding to this one, the green and chewed contents of the intestine was issuing so as to stain the fur at that point.

"Later, when I skinned the beast, I found that these last mentioned wounds showed evident signs of healing, while more recent cuts in other places proved that the owner of the skin had kept on fighting right up to the day when he got into the trap. . . .

"When it came to stretching the skin, I found fully 40 holes."[36]

THEIR MODE OF MARRIAGE

When animals fight so desperately for their mates, it generally means that they have some sort of a marriage contract in recognized form—possibly polygamy in this case, but with more evidence pointing toward monogamy. Nevertheless, this is a question not yet settled

The following observations made at my home by Mrs. Mary Vanderburgh, give a glimpse of the family life that is scarcely compatible with polygamy:

"*May 17, 1905.* To-day, as I approached the bridge on the main drive in Wyndygoul Park, I saw a Muskrat on the opposite bank, busy collecting grass. As I stood quietly to watch, he rushed down the bank, apparently in a great hurry, with the grass protruding from either side of his mouth; and swam vigorously across the pool to the near shore where I stood. He was quickly followed by another, also with a load of grass. Both swam straight under the bank near where I was, and dived. They soon reappeared, and again set out for more grass, bringing it back in their mouths as before. This they did four times, and seemed to be working very hard. The fourth time, the first to reach the shore disappeared with its burden under the bank as before; but his companion suddenly turned to the right, and dived into the waterway at another place with his grass. I did not see him again, although the other reappeared, and swam across the pool toward the grassy bank. But this time, upon reaching there, it seemed to hesitate, and then swam to a small outlet, and disappeared in the bank; neither of them appearing again, although I waited for some time.

---

[36] Forest & Stream, May 22, 1909, p. 811.

"Twice when these two animals met in midstream, but going in opposite directions, the one who had deposited his burden stopped and nibbled the face and side of the other; but the worker did not turn aside nor diminish the energy with which it made for the other shore. The pair were evidently associated, and, I think, were mates."

Finally, Miles Spencer, of Fort George, H. B., writing from personal experience, backed by many inquiries among the Indians, says[37] that the female is assisted by the male in rearing the young.

In summary, the general rule is that the males of polygamous animals do not concern themselves with the young; whereas, among the monogamous, the male divides all labour with the female, including the building and keeping up of the home. And this the male Muskrat certainly does. I have again and again seen two adult Muskrats swimming and working together in spring and early summer. In fact, it is the rule for a pair to be seen continually about each home den, as many naturalists testify.

Since such model paternalism is incompatible with polygamy, polyandry, or promiscuity, we must believe that the monogamy of the Muskrat is fairly well established.

Breeding

The breeding history of the species is but superficially known. In the latitude of Connecticut, the springtime mating is in late March. Analogy would fix the gestation at 30 days; but, so far, no definite information is on record. On the other hand, remembering the close kinship of Muskrat and Microtus, Lantz suggests that the gestation is probably 21 days.[38]

The young usually number 4 to 9, but the Biological Survey has records of 3, 6, 8, and 13 fetuses. Much higher numbers have been mentioned by some writers, but are to be received with caution. They were not actual counts, or maybe included two families, etc. Any number over 10 is very exceptional. Lantz says: "The early spring litters are usually less in number, and those of midsummer are somewhat above the average."[39]

---

[37] A. P. Low, Expl. James Bay, Can. Geol. Surv., 1888, Pt. III, p. 78J.

[38] The Muskrat as a Fur-bearer, p. 7.

As examples of the low numbers, C. S. Brimley reports "2 embryos (very small) from a female, March, 7, 1895; and one from another, July 19, 1897."[40] This was at Raleigh, N. C.

It is commonly stated that the young of early spring may breed that autumn. I do not know of any positive evidence to support this.

Some observers hold that but one brood per season is the rule with the Muskrats; others—the majority indeed—believe that from 2 to 5 broods are usual, depending upon latitude, that is, the length of the warm-weather period.

Thus, Dr. C. E. Johnson offers evidence of two broods in Minnesota. On July 23d, he says, "5 young, about one third grown, were taken at a house on the North Kawishiwi, a short distance above Dead Man's Rapids; and on the same day in a near-by locality, a female was taken which contained 7 fetuses about the size of the common House-mouse."[41]

Lantz, evidently with the Middle States in mind, sums up all available testimony as follows: "The first litter is born in April; a second litter is due in June or early July; and a third in August or September. In favourable seasons, a fourth or even a fifth litter may be produced."[42] In this connection, it should be remembered that there is a difference between "litters" and "crops." That is, there may be a crop of young ones in April, June, August, and October, without, of necessity, the same pair producing at each of these times. These questions are still open.

THE MUSKLINGS

In Connecticut, the young are born in late April. They are naked, blind, and helpless. They are suckled until three weeks or a month old. They begin to venture out about the middle of May. They are now one-third grown, and clad in fur of a peculiar leaden hue, quite different from that of the parents. In temper, too, they show an unspoiledness that proves all previous experience in the home to have been of the happiest. They have no knowledge of danger, trouble, or hate; as one must believe on the strength of many testimonies.

---

[39] The Muskrat as a Fur-bearer, pp. 6–7.

[40] Journ. Mamm., Nov., 1923, p. 264.

[41] As above, Feb., 1922, p. 37.

[42] The Muskrat as a Fur-bearer, p. 7.

Thus, Dr. Gorden Bell tells me that in late Sept., 1901, at Lake Manitoba, he saw a young Muskrat about as "big as a goose-egg," and probably one fifth grown, on a rat-house, eating a green rush. He picked it up, and it sat on his hand, still eating. Presently, he set it down again on its house, where it continued feeding without fear or loss of time.

So also, Dr. John Bachman, telling of the young ones' coming-out party, says: "They are at this time very gentle; and we have, on several occasions, taken them up with the hand, without their making any violent struggles to escape, or attempts to punish us with their teeth."[43]

George H. Measham supplies a similar incident of "childish innocence." He writes me: "John J. Moncreiff told me that, when duck-shooting from a punt at the mouth of the Red River, Man., the punt moored in a bunch of black rushes. He and his companion, Isaac Pitblado, K.C., were much amused by the actions of a half-grown Rat. There was an old rat-house right beside their punt, and this youngster came to this resting place again and again, sometimes bringing a rush for refreshment, and at other times, fussing with his toilet. He paid no need to the reports of the guns. Eventually, Moncreiff lifted him by the scruff of the neck, and set him in the punt. He scrambled out into the water, and, in a few minutes, was back on the old rat-house, content and undisturbed."

The Heroic Mother

An interesting and surprising exhibition of mother care was witnessed by Edward R. Warren—nothing less than the mother Muskrat moving her young from a place of danger. It was in the Park at Colorado Springs, on the afternoon of July 2, 1921. He saw her carry her 7 young, one at a time, from a hole in the bank to an island in the pond. She carried each in her mouth, holding it high out of the water. The moving took about an hour, and was witnessed by a number of persons besides the naturalist. It is fully described in the Journal of Mammalogy, Aug., 1924, pp. 202–03.

But the climax of Muskrat courage is set forth by W. Everett Cram.[44] He relates the brave fight put up by a large, dark Muskrat—presumably the mother—to defend her three half-grown young ones from a small Mink. Having defeated and driven away that enemy, she was back in time to achieve a second victory over a larger Mink. The story is too long for reproduction here, but is commended to all who wish to see the Muskrat in the blazing light of heroism.

---

[43] Quadrupeds of North America, I, 1849, p. 115.

[44] Journ. Mamm., Feb., 1923, pp. 22–26; 3 ills.

REFERENCES

1910—The Muskrat, by David E. Lantz, U. S. Dept. Agri., Farmers' Bull. 396; April 30; 38 pp.; 5 ills.

1911—A Systematic Synopsis of the Muskrats, by N. Hollister, N. A. F. 32; 47 pp.; 1 map; many ills.

1917—The Muskrat as a Fur-bearer, by David E. Lantz, U. S. Dept. Agri., Farmers' Bull. 869; 23 pp.; 5 ills.

1925—The Muskrat in New York, by Dr. Charles E. Johnson, Roosevelt Wild Life Bull., Syracuse, March; pp. 194-322; 41 ills.; 3 maps.

Pa Porky: "It hurts me far more than it hurts you."

LIFE XC—THE PORCUPINE

PAGE
Names 604
Description: Size, Weight, Colour, Freaks 604
Races 605
Range, Home Range, and Haunts. 605
Numbers 606
Habits in General 610
The Woodland Fool 610
Unsociable Yet Noisy 611
Love-song and War-cry 612
Solemn but Playful 613
Home and Affections 613
The Big Little Ones 615
Food When Aloft 615
Food When the Ice Is Out 616
A Salt Addict 617
The Quills 618
Are the Quills Shot?. 620
On the Defensive 621
Meeting Open Attack 622
The Fools in Their Folly 622
A Cranky Bedfellow 623
Who Shall Make Him Afraid? 624
The Terrible Pekan 624
When He Meets a Skunk 625
Porky Damage 625
His Worst Crime 627
As a Camp-wrecker 627
His Service 628
His Way of Life 629

References 633

Go Ahead - Strike!

Canada Porcupine, Gray Porcupine, Quill-pig, Prickle-cub, Hedgehog, Porky-hog, Urson, Quiller

Erethizon dorsatum (Linnæus)

(Gr. *erethizon*, ppr. of *erethizein*, to excite or irritate; L. *dorsatum*, from *dorsum*, the back, in allusion to its formidable "backing" or "back armour")

[*Hystrix*] *dorsata* LINNÆUS, 1758, Syst. Nat., ed. X, I, p. 57.
E[*rethizon*] *dorsatum* F. CUVIER, 1822, Mém. Mus. d'Hist. Nat., Paris, IX, p. 432.

TYPE LOCALITY—Eastern Canada, i.e., Quebec.

FRENCH CANADIAN, *l'Urson, le Porc-épic vélu.*
CREE, *Kahk.* Richardson gives it *Cawquaw.*
SAUTEAUX AND MUSKEGO, *Kagh.*
OJIBWAY, *Oga.*
CHIPEWYAN, *Thee.*
YANKTON SIOUX, *Pah-hee.*
OGALLALA SIOUX, *Pah-hin.*

Porkespicke is the name given by Purchas[1]. *Porty-pine* is a half-breed corruption on Slave River.

The Porcupine Family, or *Erethizontidæ*, is sufficiently characterized in the generic description.

The genus *Erethizon* (F. Cuvier, 1822) comprises thickset, short-faced, large rodents. They have the lips all hairy, head and body *covered on back and sides with long, sharp spines;* tail, short, thick, spiny above; short ears; 4 toes on fore feet, 5 on hind feet; 4 mammæ, all pectoral.

Teeth:

$$\text{Inc. } \frac{1-1}{1-1}; \text{ prem. } \frac{1-1}{1-1}; \text{ mol. } \frac{3-3}{3-3} = 20$$

To these generic characters, the Canada Porcupine adds the following:

Size. Length, about 36 in. (914 mm.); tail, 6 in. (153 mm.); hind foot, 3½ in. (89 mm.).

Weight. "Well-conditioned adults averaging from 15 to 20 pounds in weight."[2] Parke H. Struthers sends me the following summary concerning

---

[1] Pilgrimages, 1616, p. 933.

[2] Mamm. Adir., p. 300.

New Hampshire specimens, after weighing "over 100 individuals: 6 months old, weigh 6 to 9 lbs.; 1-year-old females weigh 9 to 12 lbs.; 1-year-old males weigh from 12 to 16 lbs.; adult females (over 1 year) weigh from 12 to 15 lbs.; adult males weigh 15 to 25 lbs."[3]

George A. Scott, M. L. A., shot a 28-lb. Porcupine at Davidson, Sask., in Oct., 1910.[4]

"Their maximum weight," says S. N. Rhoads, "when fat, is very great, reaching upward of 35 to 40 pounds."[5]

The following weights are recorded for the Arizona Porcupine: 8 lbs., 12 lbs., $13\frac{1}{2}$ lbs.[6]

Colour. The general colour is a brownish black; but the tips of the long hairs on the back are more or less white or yellowish-white, especially on the shoulder. The front teeth are deep orange. The quills are white with dark tips; they show chiefly on nape, rump, and tail.

Freaks. In the museum at St. Johnsbury, Vt., is a pure albino Porcupine. In the New York Zoological Bulletin for Nov., 1921, is a picture of an albino. George Shiras 3d reports one living in the woods about White Fish Lake, Ont.[7]

RACES

Two races are recognized:

dorsatum Linnæus, the typical form. T. l., Quebec.
picinum Bangs, distinguishable by its much blacker colour. T. l., L'Anse au Loup, Strait of Belle Isle, Labrador.

The Yellow-haired Porcupine (*Erethizon epixanthum*) replaces the Canada Porcupine in the Rocky Mountains from Arizona to Alaska. It differs most obviously in being streaked with yellow hairs instead of white on its body. It is found in 5 races. In habits, it is much like its Eastern cousin.

RANGE, HOME RANGE, AND HAUNTS

A comparison of the two maps—one of its range, and the other of the Faunal Areas—shows that the Porcupine is strictly limited on the south by the south edge of the Canadian Fauna, and on the north by the north edge

---

Notes.

[4] Rod & Gun, Dec., 1910, p. 972.

[5] Mamm. Penn. & N. J., 1903, p. 118. In the North Dakota State Historical Society Museum, I was shown (July 12, 1927) a large yellow-haired Porcupine taken nearby, that according to Lewis F. Crawford, weighed 44 lbs.

[6] Forester's Report, Forest & Stream, Dec., 1924, p. 729.

[7] National Geogr. Mag., June, 1911, pp. 572–96.

of the Hudsonian. There are, however, islands of Canadian in the Middle Rockies that are without Porcupines.

William Couper is responsible for the statement that the Porcupine does not occur on Anticosti.[8]

The home range of the individual is extraordinarily small. Audubon and Bachman cite[9] a case of a Porcupine that confined itself "to a space of about two acres of ground through the winter." Hearne gives another good illustration of its local fixity. He says:[10] "They are so remarkably slow and stupid that our Indians, going with packets from Fort to Fort, often see them in the trees; but, not having occasion for them at that time, leave them till their return; and should their absence be a week or ten days, they are sure to find them within a mile of the place where they had seen them before."

Robillard, my Indian guide on the Athabaska, was even more emphatic. He said that a Porky will stay all winter in a bunch of three or four trees, if it finds food enough.

This unwandering disposition, combined with the unchanging abundance of its food, has resulted in the elimination of all migratory impulse, if it ever had any.

This hemlock or jackpine woods are the Porcupine's choice of haunts. Occasionally, it is found in the hardwood, if there be also a sprinkling of conifers and a few elms, basswoods, or aspens.

NUMBERS

In my early days about Lindsay, Ont., the Porcupine was extremely rare. This, however, was on the south edge of the Canadian Zone. I did not see one on my trip from Edmonton to Great Slave Lake in 1907, the nearest approach being the skin of one hung in a bush at Fort McMurray on the Athabaska, Oct. 17. They are rare along the river; but 20 miles east of it is a sandy country with jackpines. There they are plentiful; one may see 3 or 4 in a day without looking for them. On the south shore of Lake Athabaska, they are abundant. On Great Slave Lake, they are scarce, and found only as far east as the Narrows.

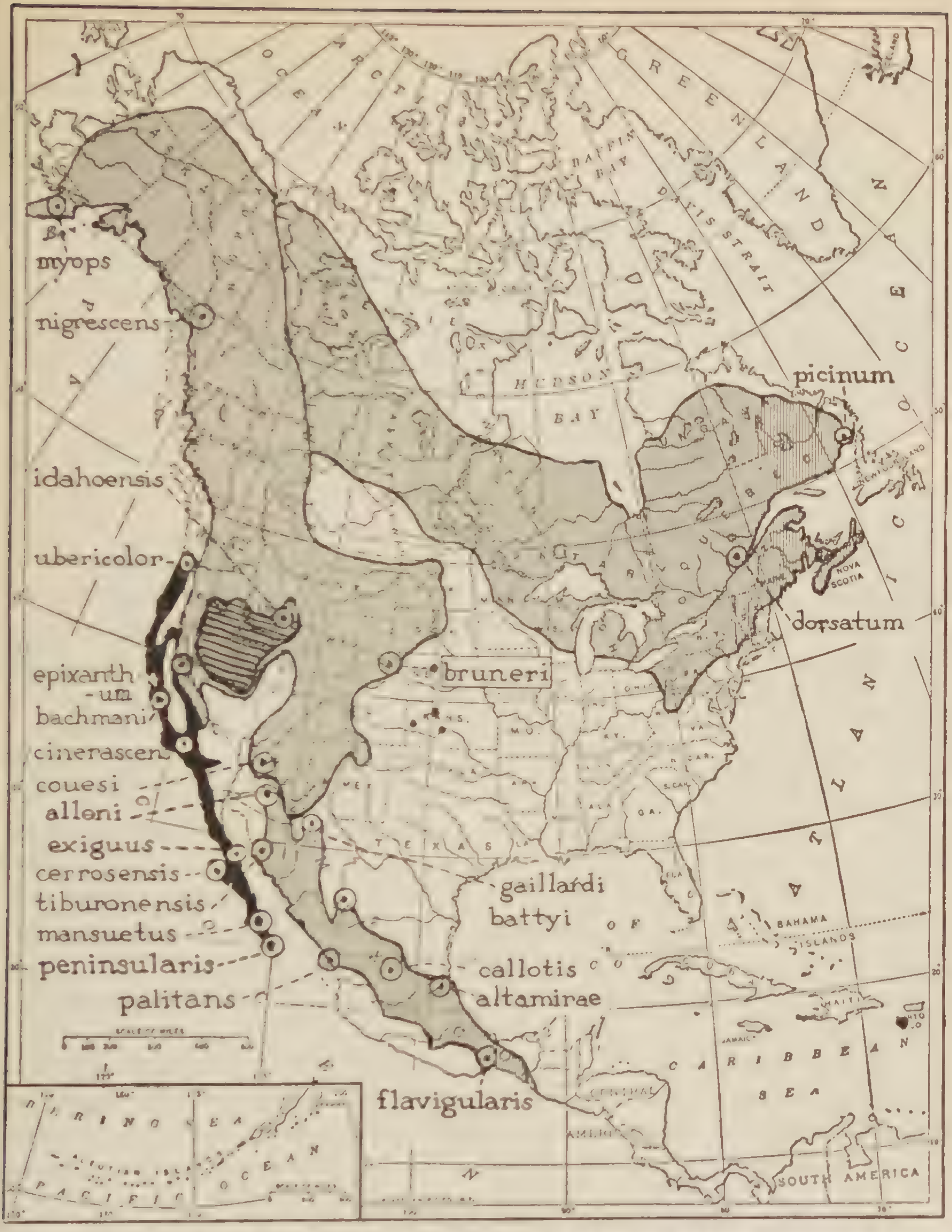
In Manitoba, I found them extremely scarce, and very punctilious about adhering to the Canadian Zone.

---

[8] Forest & Stream, June 14, 1877, p. 300.

[9] Q. N. A., I, p. 283.

[10] Journey, p. 382.



MAP XVI. RANGE OF THE PORCUPINES, OF THE PYGMY RABBIT, OF THE BRUSH RABBIT, AND OF THE ANTELOPE JACKS

By E. T. Seton, with assistance of the Biological Survey, 1927

In Itasca Co., Minn., the species is given by A. R. Cahn as "common throughout the county in suitable places; yet not nearly as common as the writer found the species either in north Wisconsin or in northern Michigan."[11]

In New Hampshire, it is according to C. F. Jackson, "fairly common throughout the northern two-thirds of the State."[12]

Struthers writes me, concerning two favourite localities in Cheshire Co., N. H. At one, Elliots, he "trapped 15 days, setting out 6 traps, and in that time have taken 35 Porcupines. In the other den, labelled 'Osgoods,' I have trapped 12 days, setting out 25 traps, and have taken 65 Porcupines." Both trappings were in 1926, and neither exhausted the local supply of the Quillers.[13]

In Maine, they are similarly abundant.

The Adirondack Mountains have more Porcupines than any other region I have lived in, but two or three a day is all one usually sees. There are, I suspect, few places to-day where they are at all numerous.

"In Labrador," says Dr. Robert Bell,[14] "the Porcupine is met with as far north as Nain, where it is common. It is met with everywhere in the region between the Great Lakes and Hudson's Bay, but is always scarce. Mr. Isbister, of the Nelson River House on the Churchill, informs me that it was once abundant there. It is rare between Lake Winnipeg and Hudson's Bay, but an individual is occasionally found as far north as York Factory."

William Case, of Cleveland, Ohio, wrote to Bachman, about 1840,[15] that Porcupines were very abundant in the Connecticut Western Reserve; "one person killed 7 or 8 in the course of an afternoon's hunt for Squirrels within three or four miles of this city."

In certain of the Catskills to-day, one may see a dozen Porcupines in a night about the camp. This, however, means that the population is concentrated there for a mile or two around. J. G. Bell tells[16] of 13 killed during one season in a grove that had about 100 cottonwood trees. This was on the Upper Missouri.

More exact data on their numbers will be found in the following from Napoleon A. Comeau's book.[17] "Prior to 1865," he says, "in the range of mountains known as the Ste. Anne Mountains, south shore of the St.

---

[11] Journ. Mamm., May, 1921, p. 72.

[12] As above, Feb., 1922, p. 15.

[13] Notes.

[14] Mamm. Hud. Bay, Geol. Surv. Can., 1884, p. 49DD.

[15] Q. N. A., I, pp. 285–86.

[16] As above, pp. 282–83.

[17] Sport & Travel on the North Shore, 1909, pp. 80–84.

Lawrence between Gaspé and the city of Rimouski, Porcupines were found in abundance, and formed part of the winter supply of fresh meat to many of the scattered inhabitants of that region. One trapper and farmer combined named Dugas, told me that he frequently killed 6 or 7 Porcupines in a day's hunt, and from 100 to 130 in a season.

"In 1865, there was a migration of Fisher into that region; and two years later, all the Porcupine had been exterminated. The very same had occurred on the north shore in recent years. In my early days of trapping, the capture of Fisher was rare; and I have known old trappers who had never seen the animal alive. At that time, Porcupines were found in great numbers, particularly in that section of the country east of the Manicouagan River to the headwaters of the Ste. Marguerite. I mention this fact from personal observation.

"It was no unusual thing for an Indian family to capture from 150 to 200 Porcupines in a winter. . . .I have crossed in one day's walking, over 30 fresh yards or winter quarters of the Porcupine. A very low estimate of the numbers killed each year in the above limits, would be about 5,000 or 6,000. This continued during the 15 years that I trapped in that region, until about 1880, when the large migration of Fisher occurred, and the poor Porcupine were doomed. In two years, they were completely destroyed."

In certain regions where the Fisher is trapped out, and the Porcupine has every chance to multiply, the species has prospered till it is a nuisance. Essex County, N. Y., is one such region. In *Forest & Stream*[18] we learn that a bounty of 25 cents per head on Porcupine resulted in 3,617 of the creatures being killed on the 1,834 square miles of its territory.

In Minnesota, the State forest lands are laid out in forties; that is, squares of 40 acres each. Writing of conditions in that State, W. T. Cox, the surveyor, says: "The Porcupine . . . has become so abundant at Itasca that it commands the attention of the Park superintendent and other foresters engaged upon work in the forest. Recently, in marking trees for an improvement cutting, 26 forties were carefully gone over. Snow lay on the ground, and it was easier to see Porcupines than it would be in the summertime; and the men were able to obtain a fairly accurate count of these animals, and to determine what damage they were doing. On the 26 forties, 76 Porcupines were seen, or an average of 3 to the forty. Since there are 560 forty-acre tracts in this particular State Forest, it would seem that there must be in the neighbourhood of 1,600 Porcupines busily engaged in girdling trees on the reserve."[19]

---

[18] Nov. 28, 1908, p. 854.

[19] American Forestry, March, 1923, p. 161.

Habits in General

The Porcupine's best speed on the ground, is slow; but it is fast compared with its movements in the branches. Here it goes about like a Sloth, when it does move; often spending days in a single tree.

In the water, it floats because of its quills. Each quill is a little barrel of air to hold the creature up; and by paddling, it manages to traverse considerable distances. A half-grown specimen that I was photographing, took to the water to get rid of me; and swam with much splashing and little speed to the other shore, some 50 yards away.

Though it feeds and travels by both night and day, there can be no doubt that, like most quadrupeds it prefers the soft light of evening and early morning, taking advantage also of the substitute furnished by moonlight.

It does not need to hibernate, and is another proof of the theory that, given abundance of food, most animals will adapt themselves to any kind of climate.

The Woodland Fool

"The stupidest thing in the woods" is the descriptive epithet applied to the Porcupine by all who know it at home. It will waddle into almost any kind of danger, and eat almost any kind of food with utter disregard of consequences.

At Ingolf, Ont., on Sept. 16, 1904, in the woods near the railway, I found a dynamite box, and a stick of dynamite one-third eaten by a Porcupine. There were no Porky remains near, so evidently, he had not chewed hard enough.

You may drive the creature out of your camp with fire and sword; but that will not prevent its coming back—if able to crawl—within half an hour, to blunder into the same mischief as brought down vengeance before.

Eugene P. Bicknell says of those in the Catskills:[20] "The seeming nocturnal temerity of these creatures appeared to be simply an exhibition of excessive stupidity. It was found impossible to drive them from the camp for any length of time; they seemed to be destitute of the faculty of memory; and even a light charge of shot sent among them, was only for the moment effectual. Even when one particularly stupid individual had been shot dead in the doorway, trying to effect an entrance by gnawing its way through a gap, another, shortly after, continued the operation beside the lifeless body of its companion."

---

[20] Transactions of the Linnæan Society of N. Y., I, 1882, pp. 121–22.

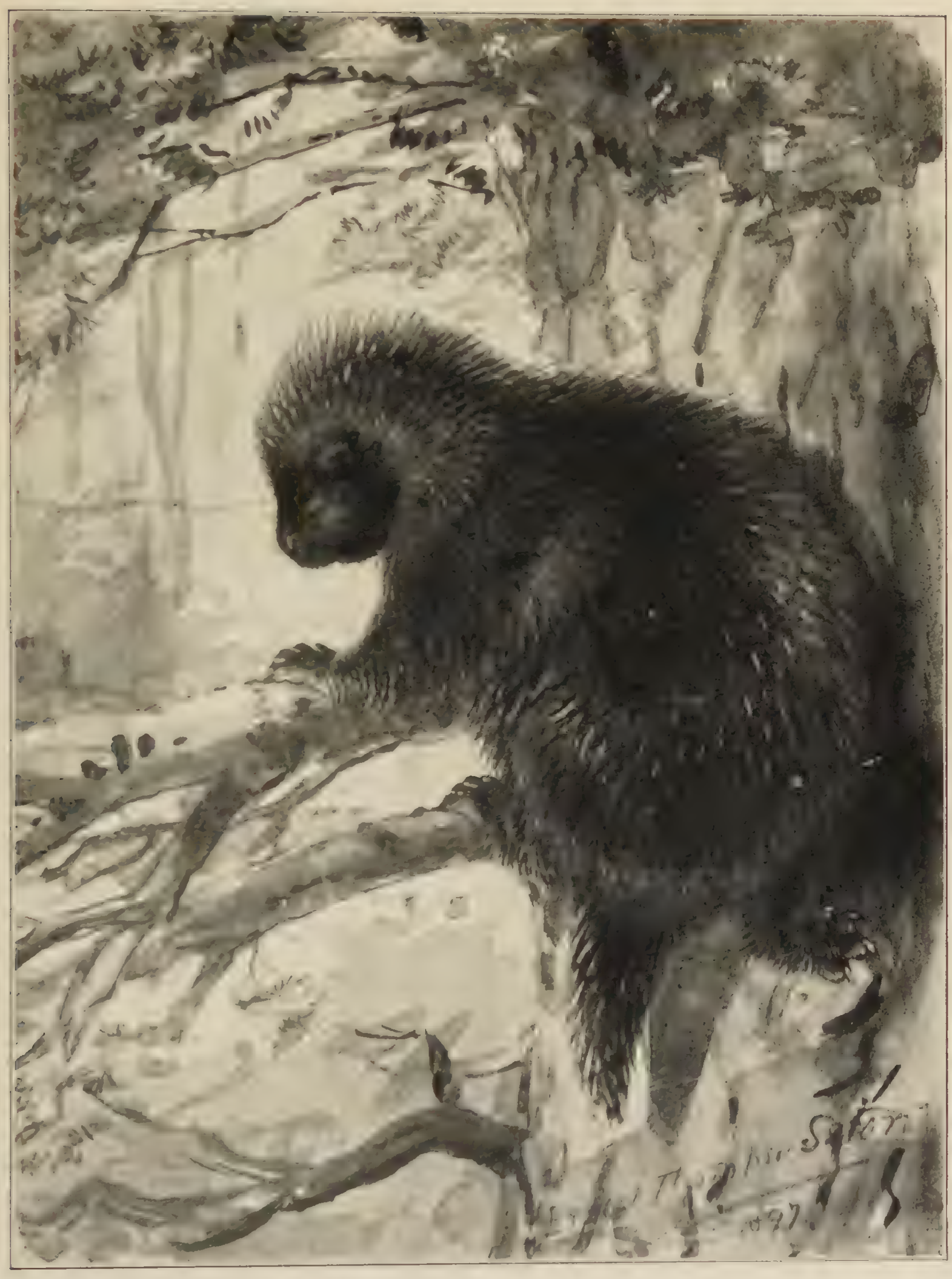


PLATE LXXIV. PORCUPINE AT HOME

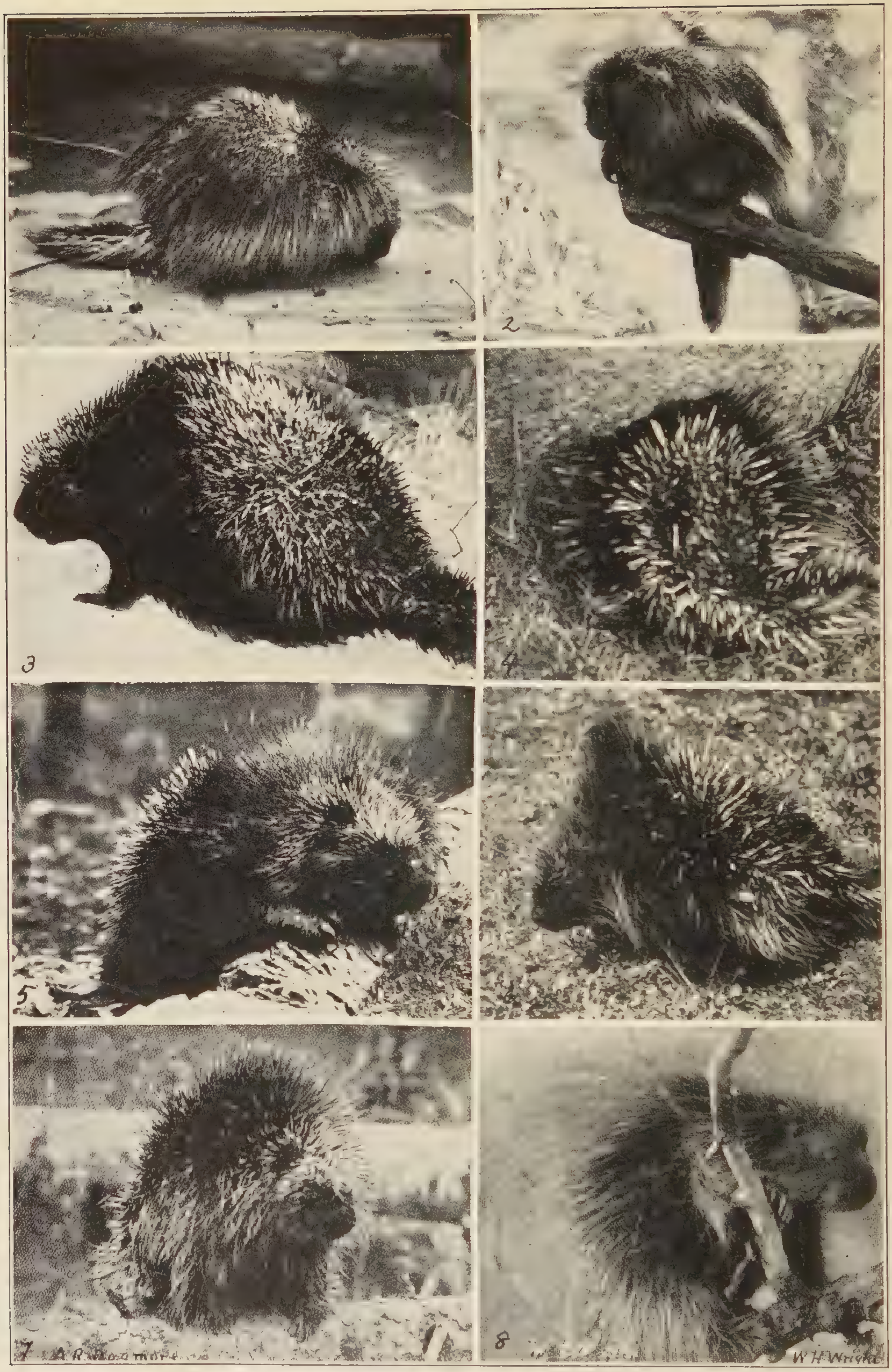


PLATE LXXVI.—PHOTOGRAPHS OF PORCUPINES

Nos. 1 and 2 are Arizona specimens in Washington Zoo. No. 8 is a Yellowhaired specimen taken by W. H. Wright. The rest are Canada Porcupines, taken by myself, except No. 7, which was taken by

No animal can manifest curiosity without having a hunger for information; and is, therefore, on the highway to knowledge. Dr. Hartley Jackson supplies us with an incident that proves, among other things, that the Quill-pig is of those who aspire to know.

"Just at dusk," he says, "on the evening of June 12, 1919, I caught sight of an adult Porcupine (*Erethizon dorsatum*) coming along a road through heavy timber in the Penokee Range, 8 miles southwest of Mellen, Wisconsin. I remained standing still. He approached in his slow, deliberate way, absolutely unaware of my presence. The air was calm, there being no detectable breeze. At a distance of about 20 feet from me, the animal stopped, looked up and around in different directions, and sniffed the air. He evidently was either rather suspicious or detected the odour of food. But he remained there only a second or two; then continued to within 15 feet; again stopped, looked directly at me, and sniffed for nearly two minutes, his nose in the air toward me all the while. Meantime, I withstood scores of biting mosquitoes, and remained perfectly silent. After 'sizing up' the situation, so to speak, the Porcupine changed his course an angle of 45 degrees, and came directly toward me. I remained silent until he began gnawing my leather puttees, when I thought it time to protest, so I made a slight movement, and Porkie scampered away and hid among the logs and brush by the roadside."[21]

UNSOCIABLE YET NOISY

Entirely unsociable and non-gregarious, the Porcupine is among the most solitary of our quadrupeds. Half-a-dozen are sometimes found gathered at a lumber camp; but these are accidental meetings. They are drawn together, not for each other's company, but for attractive foods not found elsewhere in their woods.

The Porcupine sniffs, grunts, squeaks, whines, mews, chatters, sometimes shrieks, and even cries like a child. It has, indeed, an amazing collection of noises, considering how little it seems to use them for the benefit of its kind.

Bachman wrote[22] concerning a captive specimen at Charleston, S. C., "our efforts to force it from the tree were the only provocatives by which it could be made to growl at us. We occasionally heard it during the night, uttering a shrill note that might be called a low, querulous shriek."

E. P. Bicknell thus describes[23] their numbers and their noises on Slide

---

[21] Journ. Mamm., Nov., 1921, p. 238.

[22] Q. N. A., I, p. 283.

[23] Trans. Linn. Soc. N. Y., 1882, pp. 121–22.

Mountain (Catskills, N. Y.) in June, 1882: "From evening till morning dusk, our cabin, on the extreme summit of the mountain, was virtually besieged by them; and through the chinks, their dark forms could be seen moving about among the shadows in the moonlight, while their sharp cries, and often low conversational chatter, singularly like the voices of infants, were weird interruptions of the midnight silence, or later, of the moaning wind."

Describing the vocabulary of the Yellow-haired species in Alaska, Olaus J. Murie says: "The only sounds produced by the Porcupines were a combination snort and bark, an unexpected and startling sound heard on two occasions when the animal was approached suddenly; and a moaning sound, heard once, which my companion at first attributed to a cub Bear."[24]

Concerning the chattering, Struthers writes me that he considers this the normal language of the species, and so concludes "after experimenting with my own Porcupines with whom I carry on daily conversations in the teeth-chattering dialect."[25]

Love-song and War-cry

Discussing the possibility of a love-song in the species, P. A. Taverner says that while paddling on Muskoka Lake in early spring he "heard a most peculiar succession of cries coming from the shadows. . . . It was like the continued ya-ya-ya-yaa-a-a-a of a young baby, and rose and fell with prolonged querulous quaverings. . . .

"A few days later, however, in broad daylight, the same cries were heard just back of the house; and immediate investigation showed that they proceeded from a big, fat Porkey in a small maple tree, who was telling the whole world how mournfully happy it was in the warm spring sun. I presume it was of the nature of a love-song, and for the attraction or delectation of a mate; at least, another Porcupine, presumably a mate, was found in the vicinity shortly after."[26]

George K. Cherrie writes me (Oct. 28, 1922) on what seems to be the Quiller's war-cry: "While I am absolutely sure that I would recognize the cry of the Porcupine the next time that I hear it, yet I doubt if I could describe it in a way that others might recognize the high-pitched hawklike scream that reverberated between the hills of one of my wood-lots (near Newfane, Windham Co., Vt.) on a warm afternoon, early in June.

"I had heard the scream several times during the afternoon, but did not know its source until one of my men informed me, 'Why, that's a Hedgehog!' Then I started up through the woods to verify the statement, and it did not take me long to locate the 'Hedgehog.' Not one, but two of them—about 35 or 40 feet from the ground in a good-sized hemlock. I watched them for a little time, and it was evident that there was no kindly feeling between the two. One, a very large animal, was perched near the trunk of the tree at the base of a large limb on which the smaller of the two animals clung—but 6 or 8 feet out. After due deliberation, the big fellow started out on the limb toward his smaller companion; his intentions may have been all right—I don't know, as to that—but I do know that a scream came from the smaller chap that did not sound joyous to my ears."

---

[24] Journ. Mamm., May, 1926, p. 112.

[25] Notes.

[26] Ottawa Nat., April, 1918, p. 6.

Both proved to be adult males.

Solemn but Playful

Although Enos Mills expressly says: "The Porcupine is the only animal that I have known which I have never seen play,"[27] we have some testimony in rebuttal from the pen of Mary Dartt, who wrote the adventures of Mrs. A. M. Maxwell, the woman naturalist of Denver. Mrs. Maxwell had a pet Porky of the Yellow-haired breed. Although full-grown when acquired, and very shy at first, kindness, feeding, and petting won him over; and Yockco became one of the favourites in her small menagerie. "At times," she says, "he was very playful, balancing himself on his hindfeet and tail; and with extended paws and open mouth, pretending he was about to pounce upon and bite his friends. He was quite fond of climbing into Mrs. Maxwell's lap for dainties and caresses."[28]

If his expression changed at all during these antics, he was unlike all Porcupines I ever studied.

Home and Affections

Various authorities attest that the Porcupine's nest may be in a hollow tree or log, a cave, a hole under a rock, or maybe in the ground under the roots of trees. The only one I ever saw was the winter nest of an old male near Ottawa; it was in a deep crevice of a low, rocky ledge. The bed was a poor affair; and outside of it, was a great pile of dung, showing that it had been the animal's headquarters for a long time.

The marriage customs of the Porcupines are not fully known. By all the rules and evidence, they should be very solemn affairs. Those whose opportunities have been such that they should know, have filled the unfortunate blanks with some rare and picturesque myths that need not be recorded, except by sample.

---

[27] Adv. Nature Guide, 1923, p. 205.

[28] On the Plains and Among the Peaks, 1879, pp. 50–51.

Hearne says:[29] "Their mode of copulation is singular, for their quills will not permit them to perform that office in the usual mode, like other quadrupeds. To remedy this inconvenience, they sometimes lie on their sides, and meet in that manner; but the usual mode is for the male to lie on his back, and the female to walk over him (beginning at his head), till the parts of generation come in contact."

One of my guides assured me that the female, after some vocal discussion of the problem, hung, back down, on the underside of a small limb high up in a tree, while the male took a perch on the limb above and proceeded as per regulations. This was late in October.

I never saw one of this species at the time of copulation, but witnessed the act in the Crested Porcupine, and found it not different from that of other rodents. The female had such power over the posterior quills that they were radiated out of the way; obviously, she had complete control of the situation.

Apparently, the Canada species achieves its purpose similarly; for Struthers writes me concerning a pair that he kept in the attic of his house in Syracuse: "My attention was drawn to this pair several days previous by their love-making, and always remaining near each other. My animals sleep during the day, and I noticed this pair sleeping close together. Towards nightfall (5 P.M., Feb. 11) I went to feed them, and the pair in question were in the act of copulating. The female stood on all four legs, the tail held off to the right side. The male mounted her from behind, his forelegs pressing against her sides. As soon as the male saw me, he disengaged himself so that I was not able to tell how long the act would have been prolonged."[30]

Richardson and other Northern travellers say that the species pair in September. My Adirondack guide said October. In New Hampshire, according to Struthers, the mating time is between Nov. 15 and 30.[31] Thus, the testimony is strong that the mating takes place in fall. Nevertheless, the case actually witnessed by Struthers took place on Feb. 11.

The young are born about the end of April or the first of May, according to latitude. Struthers says that in Nelson, N. H., they are born between Feb. 15th and May 1st. They are of remarkably large size, which is evidence of a long gestation.

---

[29] Journey, pp. 381–82.

[30] Personal letter, Feb. 16, 1927.

[31] Notes.

Struthers thinks that the species may breed twice each year, as he has seen young ones of but 2 or 3 pounds weight in September and in January.

The Big Little Ones

The young are said to be 1 or 2 in number, sometimes 3, rarely 4. Nevertheless, Struthers writes me that in over 79 pregnant females observed, all had but 1 fetus each.[32]

Bellalise tells me that in April, travelling through the deep snow, he once found a Porcupine and her two jet-black young ones. They were rather smooth, and had long, thick tails. This was on the south side of Lake Athabaska.

According to Merriam,[33] they "are born about the first of May [in the Adirondacks], and are monstrous for the size of the species. They are actually larger, and relatively more than 30 times larger, than the young of the Blackbear at birth. . . .

"May 1, 1882, I shot, at Big Moose Lake, a female Porcupine which contained a foetus that would certainly have been born within three or four days. It weighed 1¼ pounds avoirdupois (567 grm.), [a Blackbear at birth weighs about ½ lb.] and measured in total length 11¼ inches (285 mm.), the head and body measuring about 7¾ inches (just 195 mm.). It was densely covered with long, black hair; and the quills on its back measured a little over half an inch (13 mm.) in length. The discoid placenta measured 2¼ inches (57 mm.) in diameter."

Concerning the further development of the young, I have no information beyond the fact that, early in August, I found young Porcupines half-grown in the Adirondacks, and already leading independent lives. What time they begin to leave the nest; whether they follow their mother and are cared for by her; and at what age they are fully grown, have not yet been recorded.

All observations at hand go to prove that the father takes no interest in his offspring.

Food when Aloft

In the winter, its native food is supposed to be exclusively the bark and twigs of hemlocks, aspen, jackpines, elm, basswood, cottonwood, and other trees; of these, its favourite is hemlock. Its method of feeding is thus described by Merriam:[34] "When he has selected and settled himself in a tree to his liking, he may not leave it day or night until he has denuded it of the whole of its foliage. I have seen many hemlocks thus completely stripped, not a green twig remaining, even on the smallest bough. It seems incredible that so large and clumsy an animal should be able to climb out far enough on the branches to reach the terminal leaves; but he distributes his weight by bringing several branches together, and then, with his powerful paws, bends back their ends, and passes them through his mouth. When high in the tree tops, he is often passed unnoticed, mistaken, if seen at all, for the nest of a crow or hawk."

---

[32] Notes.

[33] Mamm. Adir., p. 305.

[34] As above. p. 302.

There is a tradition in the Northwest that the Porcupine never kills a tree if he can help it; carefully avoids a complete girdling of the bark. In jackpine woods, I have seen a great many instances that *looked* like this. But the fact is, the Porcupine climbs up to some comfortable crotch, and then gnaws at all the bark within easy reach. If there are crotches on both sides, he is likely to girdle the tree; if not, he takes the easiest way, which may mean go halfway around, then move to another fork.

The Southwestern Forest Experiment Station of Arizona reports that "in one series of experiments, a single small Porcupine weighing 8 pounds, gnawed off 34 square inches of bark in a single night. Another of 13½ pounds weight, disposed of 196 square inches in 6 days in a forest area about 90 feet square, choosing two large trees and 17 small ones. A third, a 12 pounder, took 300 square inches of bark in 6 days, girdling and killing 39 seedlings, and gnawing 32 others, as well as 5 large, young pine trees."[35]

Food when the Ice Is out

In the summer, its diet is more varied; doubtless, it eats all kinds of foods that are allowable to a strict vegetarian. Its fondness for lily-pads is well known, and is thus referred to by Merriam:[36]

"When feeding on lily-pads along the borders of watercourses, they sometimes utter extraordinary noises; and occasionally quarrels arise for the possession of some log which affords them easy access to the coveted plants. At Beaver Lake, in Lewis County, Mr. John Constable once witnessed an encounter during which one of the combatants was tumbled into the water. The animals did not attempt to bite, but growled, and snarled, and pushed."

Herrick[37] has given us interesting light on this food habit. He relates that, while out one July night, canoeing with jacklights: "Some heavy animal comes down to the water's edge where the banks are covered with a new growth of arrow-head leaf (*Sagittaria*), succulent and green; for it is June, and the receding waters have but lately exposed the roots to the sun. The clatter of teeth is again heard very loud and inexplicable, until we make out the gray form of a burly Porcupine, which at once starts up the bank much as an overfed Hog might do. A shot brought the animal to the water's edge. Another shot made it ours, and we found it an immense animal measuring over 3 feet from its blunt muzzle to the end of the spiny tail. The stomach of this specimen, a full-grown male, contained nothing but the finely comminuted shoots of *Sagittaria*."

---

[35] Forest & Stream, Dec., 1924, p. 729.

[36] Mamm. Adir., p. 303.

[37] Mamm. Minn., 1892, p. 247.

Alvin R. Cahn says that in Itasca Co., Minn., the Porcupine "prefers the hardwood thickets, and feeds largely on the top-most branches of the ash (*Fraxinus americanus*) and the aspen (*Populus tremuloides*). Along the lake shores, it feeds upon the succulent stems and roots of the arrow-heads (*Sagittaria* sps.) and the white water-lily (*Castalia odorata*)."[38]

In amplification of this, Dr. C. E. Johnson says: In Minnesota "the majority of the Porcupines seen were met with while they were feeding at the edge of some lake or stream. In a number of instances, they were observed eating the rhizomes of water-lilies that had been pulled up by the Moose. The Porcupines were at times seen to secure this food, and no doubt also other kinds found in such places, by reaching down into the water full-length of the arm, feeling about until some object was encountered, and then hauling it in with the hand."[39]

This prepares us for the statement attested by several that the Porcupine follows the Moose around to profit by the roots of water-plants pulled up by the big brute as he feeds on the rhizomes of the lily.

Struthers details a case in which the Porcupines ruined a 3-acre field of corn, devouring it in less than a week. This was near Nelson, N. H.[40]

A SALT ADDICT

There is one very marked departure from its vegetarian diet that the Porcupine continually makes; and that is, it eats any sort of salt pork or butter that it can find, doubtless disliking the grease, but forcing it down for the joy of the salt. It is so keen after this delicacy that it will gnaw up every bit of wood that tastes in the least degree briny.

I have many times visited old mining shacks in the Rockies and lumber camps up the Ottawa, to find that the common fate of every wooden article of furniture in the kitchen, from the meat block to the soup ladle, was to be devoured by Porcupines for the sake of the salt they held. It seems to be this weakness that brings them about the camp, where they are such a nuisance; and this, therefore, more than any other trait, brings on their death sentence from man. Doubtless, it is this hankering for salts and grease that makes them gnaw the cast antlers of Deer.

---

[38] Journ. Mamm., May, 1921, p. 72.

[39] As above, Feb., 1922, p. 38.

[40] Notes.

I think it likely that the craving for salts is the explanation of the following by O. J. Murie, concerning the Yellow-haired Porcupine in Alaska. He says: "Early in June of 1921 . . . on the Robertson River, I found Porcupines abundant on the river banks and sand-bars. Judging by my observations at that time, the Porcupines were feeding exclusively on mud. I watched many of them, and almost invariably saw that they were licking or chewing the fine sandy soil of the bars or river bank. At a distance of a few feet, one could hear the gritting of the sand in the animals' teeth, and could plainly see that there was not a vestige of vegetation near."[41]

THE QUILLS

But the central thought in the Porcupine, the wonderful peculiarity, the secret of its life indeed, is its quill equipment. To specialize and grow quills, it has relinquished speed, cunning, and keenness of senses; all the revenues of its body seem to have been converted to the growing of those awful spines; and in the primitive times, when first evolved, the idea was absolutely justified by results.

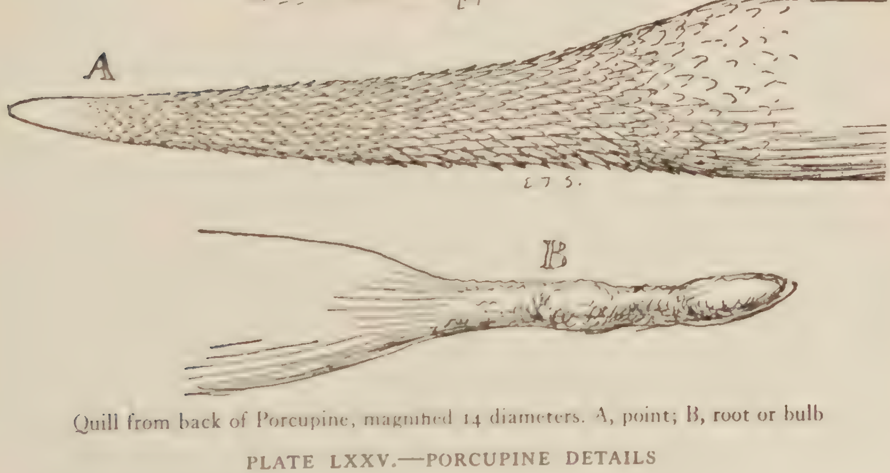
The quills are about one inch long on the head, and 4 inches on the back; they are absent from the muzzle, the underparts, and the legs. They are so hidden in the wool and hair that they are hard to see, but are always unpleasantly easy to feel. They are so thickly placed that a Porcupine stripped of its wool and hair, as I have seen it by partial decomposition, is still clad densely with quills; each of these is a keen, many-barbed, and poisonous dagger.

Through the courtesy of the Geological Survey at Ottawa, I have had the opportunity to make an enlarged drawing of a representative quill (Plate LXXV, p. 619). The specimen was taken from the back of a stuffed Porcupine (*E. dorsatum*). I expected to find those of the tail more highly specialized, but was disappointed. Examples from head, back, and tail differed chiefly in size.

The extreme point is polished and keen. Very soon, i.e., after $\frac{1}{32}$ of an inch, the barbs begin to show; these die away on the shoulder of the quill. I reckoned up a round thousand barbs on this specimen. When soaked in warm water, they stuck out much more; so we may believe that they also

---

[41] Notes, May, 1926, p. 111.



Quill from back of Porcupine, magnified 14 diameters. A, point; B, root or bulb

PLATE LXXV.—PORCUPINE DETAILS

flare out when in the warm flesh of the victim. The barrel is smooth, and highly polished. The bulb or root presented no special features.

A large male, taken at Berlin, Rensselaer Co., N. Y., Jan. 14, 1924 (No. 67892 Am. Mus.), on careful examination by G. G. Goodwin and myself, gave the following as conservative results of a count:

Head (armoured part)	12½ sq. in.,	100 quills per sq. in.	1,250
Body “ “	240 “ “	140 “ “ “ “	33,600
Tail “ “	16 “ “	100 “ “ “	1,600
			36,450

A representative female collected at the same place by Goodwin, gave, on careful calculation, a total of 24,480 quills.

Thus, Porky is protected by over 30,000 poisonous daggers, each more dangerous than the sting of a wasp! Imagine having 30,000 fearless wasps eternally on guard for your protection!

Thirty of these quills will repel a Dog; therefore, each Porky, we may say, is equipped to defeat 1,000 Dogs, as quickly as they care to come on.

How long it takes to grow a quill, is not known. But no one ever saw a wild Porcupine with bald spots, or any apparent shortage of spears. I suspect that, after even a serious affair with some enemy, the Porky will be wholly requilled before three months have passed by.

ARE THE QUILLS SHOT?

The quills on the head and body are defensive; those on the tail are offensive, for the latter is thrashed about vigorously at a foe. The daggers, as a rule, leave the creature only after the point has entered the enemy; for, at the Porcupine's end, the quill is very loosely set in, and at the foeman's end, it is very tightly fixed, once it enters; and it has a thousand barbs to rankle and clinch, and defy all efforts to remove it.

Whether the festering of a quill-wound is due to an active poison on the point, or to the barbs, is unknown.

The quills, as is well known, are daggers, not arrows; for the creature does not shoot them at his foeman. Nevertheless, there can be no doubt that they are sometimes *thrown*, in a limited sense. Thus, L. V. Shaw, of Clements Port, Nova Scotia, writes on this subject:

"By a sudden jerk of his powerful tail, I have seen him throw loose quills a good distance; and if your flesh was close enough, probably [they would] stick in, and left serenely alone, would surely go through you."[42]

---

[42] Forest & Stream, June, 1924, p. 346.

Alexander H. Leighton, of Rosemont, Pa., says: "While hunting with a camera in the woods of Nova Scotia, during the summer of 1923, I saw a Porcupine, not 'shoot,' but throw his quills at least 5 feet, and strike a man. We found this Porcupine in a tree which we cut down; and my guides, with the aid of long, forked sticks, began driving him toward an open place where I should have light enough to photograph him. Suddenly, he took a notion to charge down a little path in a direction we did not wish him to go. One of the guides jumped in front of him, and held out a stick at arms' length to stop him. The Porcupine flicked his tail, and sent two quills into the guide's shoulder." Of course, as Leighton concludes, "the quills in the Porcupine's tail were loose, and struck the guide merely by accident."[43]

Unexpected use for the tail is announced by O. J. Murie. He says of a Porcupine that he watched closely: "Slowly and cautiously, it would hitch its way up the trunk, using the tail as a prop. The stiff bristles on the under surface were very useful here."[44] This carries us back to woodpecker methods.

On the Defensive

How are these daggers used? The creature does not curl up into a many-rayed globe—Hedgehog or globe-fish fashion—as some have told. I have tried many times to make it do so, without success. Indeed, if the animal be turned on its back (and it costs the investigator much effort to turn it, as it is sturdy on its legs), it lies exposed and helpless; which would not be the case if it had the habit of making itself into a ball. The old hunters say it never does so, except, perhaps, when falling from a height; and then it opens out on striking the ground. After many opportunities to observe, I can state that, on meeting an enemy from which it cannot escape, the Porcupine tucks its head under a root, a log, or other cover; raises its quills, radiating them all ways from the small of the back, and lashes with its tail at the slightest intimation of the foe being near. If it has no cover for its head, but happens to know of one in the direction of the enemy, it backs toward that switching its tail to clear the way. And there be few creatures indeed that do not heed the warning.

An adult female which I caught on the Oswegatchie, N. Y., was held with a noose on its hind foot while being examined. The foolish thing so resented this indignity that it lashed its own out-stretched foot full of quills; and it cost us no little trouble to get them out—as we felt in honour bound to do—before we let the fretful one go free.

---

[43] Journ. Mamm., Feb., 1926, p. 61.

[44] As above, May, 1926, p. 112.

MEETING OPEN ATTACK

Bachman has left us this very exact picture of the Porcupine repelling a foe:[45] "A large, ferocious, and exceedingly troublesome mastiff, belonging to the neighbourhood had been in the habit of digging a hole under the fence, and entering our garden.

"Early one morning, we saw him making a dash at some object in the corner of the fence; which proved to be our Porcupine, which had, during the night, made its escape from the cage. The Dog seemed regardless of all its threats; and, probably supposing it to be an animal not more formidable than a Cat, sprang upon it, with open mouth. The Porcupine seemed to swell up in an instant, to nearly double its size; and as the Dog pounced upon it, it dealt him such a sidewise lateral blow with its tail as caused the mastiff to relinquish his hold instantly, and set up a loud howl in an agony of pain. His mouth, tongue, and nose were full of Porcupine quills. He could not close his jaws, but hurried open-mouthed out of the premises.

"It proved to him a lesson for life, as nothing could ever afterwards induce him to revisit a place where he had met with such an unneighbourly reception. Although the servants immediately extracted the spines from the mouth of the Dog, we observed that his head was terribly swelled for several weeks afterward; and it was two months before he finally recovered."

What dreadful punishment, in spite of immediate and skilful human aid! What would have been the offender's fate had he been a wild animal? Assuredly, death. The records of natural history abundantly prove it.

THE FOOLS IN THEIR FOLLY

"We have mentioned in our article on the Canada Lynx," says Bachman,[46] "that one of those animals was taken in the woods in a dying state, owing to its mouth being filled with Porcupine quills. We have heard of many Dogs, some Wolves, and at least one Panther, that were found dead, in consequence of inflammation produced by seizing on the Porcupine."

Manly Hardy lists the Fox, the Raccoon, and the Wildcat, among those he has found dead, slain by the quills of the Porcupine.[47]

On Sept. 16, 1901, in Rio Blanco Co., Colo., I found a Fox at the point of death from the quills of a Porcupine that he must have attacked some weeks before.

---

[45] Q. N. A., I, p. 281.

[46] As above, p. 285.

[47] Shooting and Fishing, April 13, 1899, p. 526.

In the Blackbear Life (Vol. II, p. 145), is related the frightful punishment and miserable death of a Bear that essayed to make a meal of the Quiller.

Charles A. Wilding, of Fort Wayne, Ind., tells me that during a fishing trip into Canada, he once captured a huge snapping turtle whose fore feet were stuck full of Porcupine quills (Dec. 17, 1920).

A remarkable case of a horned owl, shot shortly after it had attacked a Porcupine, is detailed by C. E. Eifrig, of Ottawa, Ont.[18] It took place in Dec., 1907, at a place 50 miles northeast of the city; 66 Porcupine quills were taken out of that misguided owl's body.

In *Forest & Stream* of March 20, 1884, p. 144, J. L. Davidson, of Lockport, N. Y., states that he had recently examined a golden eagle that had been shot at Plessis, Jefferson Co., N. Y. He says: "The feet of the eagle were full of Porcupine quills, which was probably the last animal he had dined off."

In the *Auk*, April, 1922, p. 259, is an account by Albert Lano, of Fayetteville, Ark. It details the defeat and ultimate death of a golden eagle that tried to destroy a Porcupine.

An even more tragic affair has just been reported to me by the Postmaster of Laingsburg, Mich. Milton Williams, of that town, found an American eagle dead, and filled with quills that had evidently caused its death. Without doubt, the eagle had attacked the Porky, and had paid the extreme penalty of his folly.

A careful search in the annals of natural history will eventually put on the list of "killed by Porcupine" every savage flesh-eater in the region where the Quill-pig dwells.

A CRANKY BEDFELLOW

The final and most amazing instance of the Quill-pig's power is found in the following. It is suggestive of the female spider that makes a practice of destroying her husband the morning after the wedding night. Dr. George W. Harvey, telling how his boy and his Dog Bose managed to do a Porky to its death, says:

"The next afternoon, the boy skinned and dissected the Porky, just to see what he had been eating, and how he was made. He first found that Bose had bitten the Porcupine's backbone in two in two places; and second that his intestines were perforated in no less than three different places by three of his own, a rival's, or his lady-love's quills, which, if the latter, would be Cupid's darts literally. In each instance, the quills were entirely through the intestine; an end protruding from either side, and held in place by a spindle-shaped ball of fecal matter, that must have revolved as the waste moved through the bowel like a shaft bearing a pully.

---

[18] Auk, Jan., 1909, p. 58.

"In spite of these intestinal perforations, the Porcupine was as fat as a Seal; evidently in perfect health, and enjoying life to the full."[49]

WHO SHALL MAKE HIM AFRAID?

Who, then, are the enemies that this fearless one should fear? Setting the least first, we must begin with forest fires. The Deer and the Wolf can run before them or turn aside to purer air. But the slow Porcupine is enveloped in stifling fumes that extend their path of death for miles down-wind; and the higher he climbs, the surer his fate. For three years after the 1898 forest fire on the White River Plateau of Colorado, no Porcupines were seen.

But the fire is local and transient. The knight of many spears carries a worse foe within his own coat of mail—invisible, hidden, incombatable—and such are ever among the deadliest of foes. The measure of their damage is not known; and yet, of this we are assured: There are none worse. This secret plague, like the secret thought that dissolved an empire's army not so long ago, is no more than a worm—a tapeworm—the body-sapping *Bothiocephalus*.

THE TERRIBLE PEKAN

It will be noted that in the list of creatures that fear the Quill-pig, we do not find the Pekan-Fisher. For reasons not understood, but set forth—as far as known—in the Fisher Life (Vol. II, p. 476), the Fisher is immune to the quills. He has no fear of Porky's attack. He loves Porky meat, and makes of him his favourite prey in countries where the Quiller still abounds. He is the chief natural foe of the Porky.

As we have already seen, there is a close relationship between the number of Porcupines and of Pekans in eastern Quebec. Similarly, the clearing out of the Pekans in western New York about 1820, was followed by conditions thus recorded: "Mr. Cozzens states that, of late years, they [Porcupines] have multiplied greatly; and are become numerous near Oneida Lake and in the northwestern part of the State of New York."[50]

As already noted, the Spiny's position of defense is with head thrust under any log or root; or, failing that, between his own fore legs, his belly hugging the ground, while his tail with lashings much more dreadful than those of Lion or Bull, girds blindly at the foe. But the Pekan, with foxy craft, and arrowy speed, attacks, not with foolish canine jaw, but, with insidious catlike paw inserted underneath; upsets the dull, dazed skinner of the trees, and tears his belly open ere he can regain his invulnerable pose.

---

[49] Forest & Stream, May, 1926, p. 280.

[50] J. & T. Doughty's Cabinet of Nat. Hist., I, 1830, p. 242.

Why the Pekan does not suffer as do others of the red-toothed kind, is unknown. He is prodded and speared as others are; yet seems to live. Once only have I heard of a Fisher that succumbed to the barbs of the vengeful Quill-pig.

If he escape the attacks of all these foes, and succumb not to the traitor in his bowels, how long may Porky live? The only testimony at hand is this —that at White Fish Lake, Mich., was an albino Porcupine that George Shiras 3d photographed successfully for 6 consecutive years;[51] from which we may argue that the species may live at least that long. By the rule of 5 times the period of growth, the Porcupine may, barring Pekans and other accidents, live to the ripe age of 10 or 12 years.

When He Meets a Skunk

On the title page of this volume are figured the two Invincibles of the Woods—the two that have the right of way, the fear-born reverence of all dwellers in the wilds—the Skunk and the Porcupine. When these two meet—when the invincible meets the invulnerable—what next?

Enos Mills alone was privileged to see that meeting, and thus reports it: "Dull fellows well met were Skunk and Porcupine. These dull-brained but efficiently armed fellows are conceded the right of way by conventional wilderness folk. They blundered to head-on clash. Never before had this occurred. Each was surprised and wrathy. There was a gritting of teeth Each pushed and became furious. Then the Skunk received several quills in the side, and, in turn, the Porcupine a dash of Skunk spray. Both abandoned the trail, sadder but not wiser."[52]

The Skunk would pay the heavy penalty, after weeks of pain; the Quill-pig would recover in three days. Is not this a proof of which has better weapons?

Worst, last, and deadliest of the Quill-pig's foes is man, as we shall see.

Porky Damage

Man has been the inveterate enemy of the Porcupine for three main reasons:

---

[51] Nat. Geogr. Mag., June, 1911, pp. 572–91.

[52] Watched by Wild Animals, 1922, p. 120.

First, damage to the hunting Dogs. Dogs are courageous enough to attack any foe, when they know that, backing them, is a man with a gun. In such a cocksure attitude, then, the Dog goes forth to destroy every living thing that it can find in the woods. It meets a baby Rabbit or a stranded half-grown Woodchuck, and on this it works its valiant will. Then it meets a Porcupine, and rushes mouthily upon him—to receive the punishment that a bully deserves.

"Around Anaconda, Mont.," writes T. L. Holliday, "the dog-lovers rightly consider the Porcupine a curse. I, for one, never let one escape if I can help it. We dare not go . . . hunting with the Dogs without taking our long-nosed electrician's pliers with us; for we never know when we will have to pull quills, and this tool is indispensable, especially to reach spikes that are far back in the mouth and on the tongue.

"In some cases, when Dogs are badly quilled, . . . and ether or chloroform is unavailable, it is impossible to save the Dogs. The two bitches . . . and one other old battler, 7 years old, were put under ether, and gone over very thoroughly, taking our time; but in spite of our care, I am yet pulling an occasional quill that works to the surface, point first. Yesterday, I took one out of the corner of the eye; to-day one came out through the very end of the nose; it has come up between the lip and the teeth."[53]

After one or two such experiences, some Dogs learn wisdom; but most do not.

Allan Brooks says:[54] "There are Dogs so pugnacious they attack every Porcupine they find, year after year. I once knew a bull Dog that killed dozens of them. Of course, he always got his face full of quills; and after the fight, would present himself at his master's house to have them pulled out. He was a big, powerful brute, and it always took two men to hold him while a third played dentist. Some of the quills would break off, leaving the barbed point imbedded in the flesh. These would invariably work through the Dog's head, and come out on the opposite side. Frequently, his head would, for a week or two, be swelled to twice its normal size. Running sores would result from the action of the quills; but still the plucky Dog would go after the Porcupines, even while his head was swelled till it looked like a Yankee pumpkin."

The fact that man is at hand with pinchers and salves does not, by any means, guarantee that the Dog will be all right in a month. In spite of immediate help, many a Dog has paid with his life, for an attack on the Tree Skinner. Yes, one may state it with even greater vigour—thousands of Dogs have been killed by the combination of the Quill-pig's weapons and their own destructive folly. For this reason, all dog-men hate the Porcupine, utterly forgetting that Old Quills was never the aggressor, but was, in each case, merely defending his life in an unprovoked and unfair attack of 20 to 1 against him.

---

[53] Field & Stream, Nov., 1921, p. 739.

[54] Western Porcupine, p. 343.

His Worst Crime

But the blackest crime with which our hero is charged is one that touches man's pocketbook. A stand of good timber is wealth; and the amount of potential wealth that one Porky can wipe out in a winter, is appalling.

Bachman credits the creature with destroying 100 big trees in a winter by girdling the bark.[55]

W. T. Cox, the lumber-cruiser, reporting on the conditions in the Minnesota pineries, says: "Careful note made as to the work of these animals, showed that each one had recently girdled and killed on an average 4.9 white pine trees. The trees were of an average diameter of 15 inches, representing the equivalent of 950 board feet of timber killed by each animal, or a total of 69,500 board feet on the 26 forties. This timber has a stumpage value of $8 per thousand feet. It will be seen, therefore, that the Porcupines of Itasca Park and Forest are killing each year approximately a million and a half feet of timber, worth on the stump $16,264, or approximately 1.2 per cent of the present annual growth. They constitute a source of damage which must be reckoned with in the management of the property."[56]

As a Camp-wrecker

Once a Porcupine has discovered your camp with its store of soups, salts, and flesh-stuff, nothing will restore peace by night but a wholesale massacre.

"To leave the soap out overnight," says Brooks,[57] "in a Porcupine country, means you will have to use sand to scrub with, the rest of the trip. The Porcupine will invariably get into any trap set for more valuable animals; and after eating up the bait, will sit comfortably down and await events, without trying to pull out."

In some mining regions, where rubber hose or automobiles are in use, the Querulous Quiller has developed a taste for rubber that adds to his unpopularity.

---

[55] Q. N. A., I, p. 283.

[56] American Forestry, March, 1923, p. 161.

[57] Western Porcupine, p. 343.

You may drive him away, or shoot his wife or brother at his side—he will be back before you have been asleep more than ten minutes, to rattle his teeth on your saucepans, rasp and chip on the stock of your gun, squeal and whine and stamp as he squabbles with his friends. There is not a piece of wood in camp that he will not destroy if it be redolent of pork grease, or of sweat.

For these things, he is hated by campers.

His Service

Against infrequent fires and winter-famished Fishers, the Porcupine could still hold out. But man, in addition, was overmuch, and the balance turned. Quills grew scarce in all the lumber-woods.

Then a new thought came. Lumber-cruisers in the pineries got lost from time to time; and, armed only with a blazing-axe, they must find a Porcupine or starve. As these animals grew rare, the men *did* starve. So a new law exists to-day—the thorny rodent is protected under grievous penalties; and none but the starving may molest him. Furthermore, since his chief enemy is also the enemy of his enemies, and has killed off the Fishers, the Spiny race is prospering again.

The Indians have always viewed the Quill-pig as a food supply. Hearne says: "The flesh of the Porcupine is very delicious, and so much esteemed by the Indians that they think it the greatest luxury that their country affords."[58]

As we have already seen, the farmers as well as the hunters in the Rimouski region count, or used to count, on the Porcupine as a staple in their winter diet. Allan Brooks describes the flesh as "sweet and wholesome";[59] and discriminating testimony is offered by William S. Brown, of Alturas, Calif. He says:[60] "I have eaten Porcupine meat on several occasions during the past summer, and found it to be quite palatable. Only for the fact that the meat is coarser in texture, one could imagine he was eating beef—provided, of course, that the Porcupine is young. An old Porcupine is the toughest chewing imaginable." In this we see his use to man to-day.

But in bygone days, also, the Porcupine cut a large figure in the lives of our red brethren. George P. Belden says:[61] "The Crow Indians are the only ones who make combs. They are very simple, and consist of a Hedgehog's tail, the bristles serving as teeth. When the Hog is killed, the tail is skinned off the bone, and a wooden handle inserted. When dry, it is ready for use, and is by no means a bad substitute for the bone or horn comb we use. A Hedgehog comb is an indispensable article to every Indian girl, as it enables her to keep her long black hair in order."

---

[58] Journey, p. 381.

[59] Western Porcupine, p. 343.

[60] Cal. F. & G., April, 1921, p. 127.

[61] Belden, The White Chief, 1872, p. 122.

A still more æsthetic service was rendered by the Quill-pig. The quills—always the quills—were sought after by the Indian women for their fancy work. They were ready-made laces with a ready-made needle at one end. Dyed with roots, berries, barks, and lichens, to a buff, brown, black, red, green, and yellow, or left their natural white, they proved excellent material for the gorgeous embroidery of coats, moccasins, robes, and canoes. These things are famous now as the Red-man's art—an art that we believe was far too true to die; and yet will wield its influence in our modern world, even though it was the savage outcome of a savage's idea, expressed in the spines of a stupid beast, stained in dyes of the plants that it fed on.

His Way of Life

"Yes, that's something I *can do*," said Woodman Dobson. "I can take you to a Hedgehog. When it comes to Foxes, Coons, or even Deer, it's a gamble, but I can sure show you a Hedgehog." And so we set out from our camp on the Oswegatchie River.

An old camp is always a likely place for these creatures; and our first objective point was up the river, a mile and a half, to an abandoned logging shanty. There were plenty of Porky signs about the place. Every piece of wood that had been tainted with salt or grease was deeply gnawed; doubtless, the spiny ones found something here to fill a long-felt want. But not a Porky was to be seen. We tramped off through the woods, and after an hour came back. Dobson was ahead, and as he entered the tumbledown kitchen, shouted: "There he is! Look out, now, or he'll dodge into a hole!"

I hurried forward to see the Porcupine in a little wall-cupboard, where he had been enjoying the greasy, unsucculent shelf. But he had no desire for our acquaintance, and began to scramble down. Snatching a plank to serve as door, the guide shut him into this cupboard. I tore the whole box from its fastenings, and we carried it into the sunlight.

The activity of that spiny creature, and the energy and wrath with which he ground his teeth, were somewhat in contrast with the slow, logy Porcupines I used to know in Canada; and to prevent his escape, we had to slip a wire noose over one hind foot.

First, I examined him closely, and found that the summer moult was so complete that his upper rear parts were naked except for the quills. These, when raised, radiated from the small of the back, or where that ought to be; in this case, it looked more like the broad of the back..

When tapped on the head or front parts, he tried to turn around; if touched on the hind parts, the tail flew up, or to one side, and left, in the offending stick or boot, a number of quills.

At length he broke the wire, and made off. I ran in front of him, whereupon he turned his back and came on, switching his tail viciously. I held up my foot; he struck the sole of my boot, and left half a dozen quills in it.

We now managed to get another noose on his hind foot, but the moment the leg was pulled straight, he switched that foot full of quills. Here was a quandary. Having made the necessary photographs, we had no right to let the Quill-pig go with his leg full of quills; and so, with much trouble and some danger—for Dobson got a couple of quills in his hand—we freed the Quiller from his own darts, and set him at liberty.

During this affair, that Porcupine lost not less than 150 of the poisoned daggers. .It makes one wonder whether, in a series of encounters, he may not run short of ammunition.

All attempts to make this one climb a tree, or roll up like a ball, were failures.

The next day of our search, we passed through a grove of aspens. On the ground was the unmistakable after-evidence of a Porky feast, and I found the feaster dozing in a crotch some ten feet up. A deft push with a pole brought down the over-secure one; and he proceeded to perform for us, making first for a root under which he stuck his head. He defied us with fierce and rotary sweeps of his tail. A noose was slipped over a hind foot so we could hale him into full daylight, and again our prisoner lashed his own foot full of poisoned daggers. As before, we could not make him "ball." Then, as in duty bound, we held him under forked sticks, and removed the spears from his foot before letting him go.

He ran out on a log that was in the water; when I followed, he *retreated toward me* with threatening tail. Then at length he took to the water, and swam slowly, splashily, to the other side, some 50 yards away.

Yet again, I tried to photograph the Porky in the Adirondacks, at Loon Lake, in Aug., 1909. A native showed me the resort of a "Hedgehog." A load of barrels had been carried into the woods, with water to fight a forest fire. They had been left there; and, being pork barrels, attracted the Porcupine, who came and gnawed whenever he felt like having a chew. I went alone every day for five days, without seeing anything but a few fresh signs.

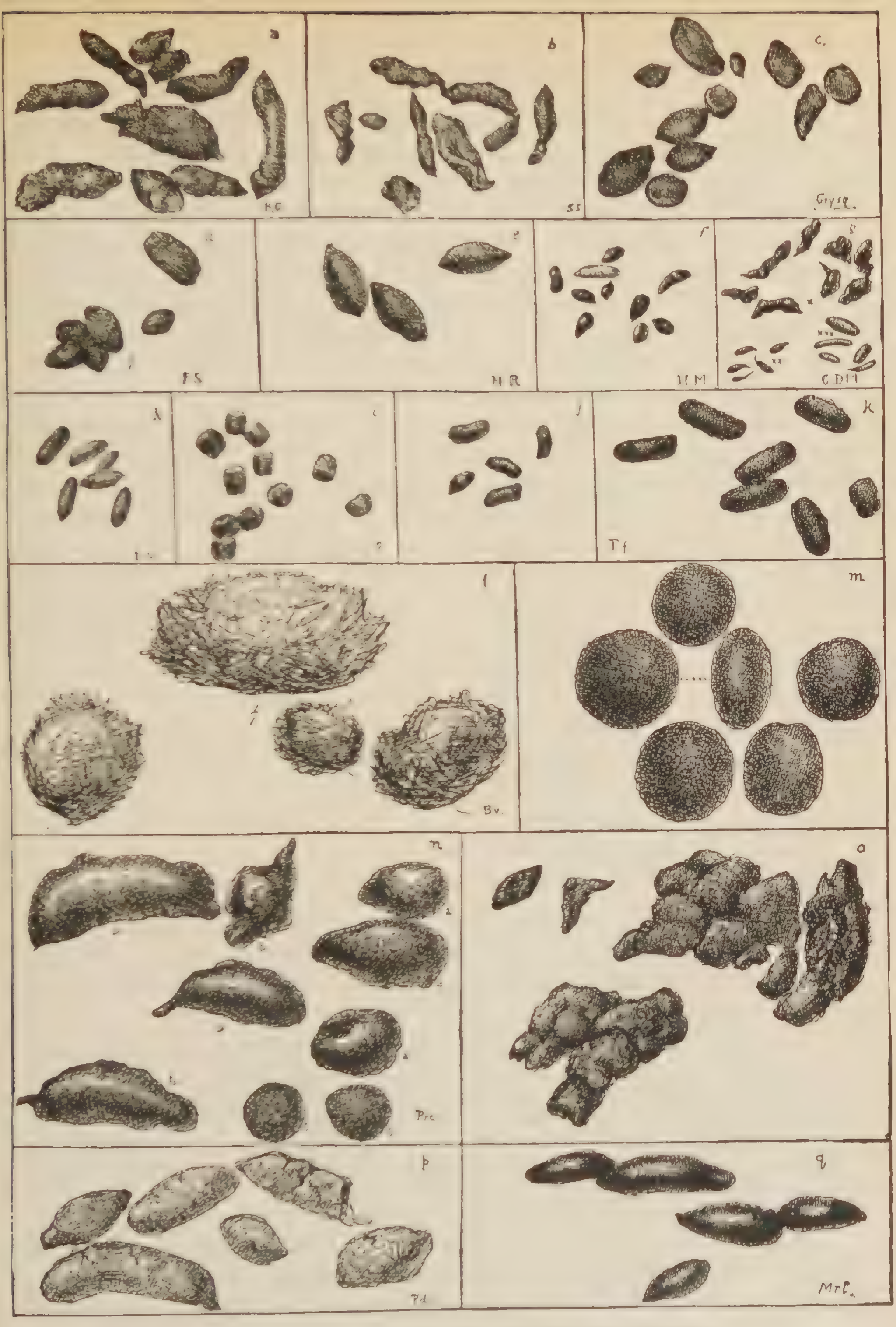


PLATE LXXVIII.—SCATOLOGY OF CERTAIN RODENTS

a. Richardson Ground-squirrel *b.* Thirteen-striped Ground-squirrel. *c.* Carolina Gray-squirrel. *d.* Southern Flying-squirrel (*volans*). *e.* House-rat, living in the woods. *f.* House mouse. *g.* Connecticut Deer-mouse (*noveboracensis*) (*x*) Fed on bread, etc (*xx*) Different individual the night after capture. (*xxx*) Same as last, nut-fed for days. *h.* Drummond Vole. *i.* A Centipede. *j.* *Synaptomys cooperi*, ‡ Ottawa River. *k.* Pocket-gopher (*T. fossor*). *l.* Beaver, all woody fibre. *m.* Snowshoe-rabbit (winter). different individuals, the large (*b*) wild, the others (*a, c*) captive. *o.* Woodchuck in October. *p.* Common

On the sixth day, I had a premonition of success, that was founded chiefly on a determination to win. I put a wire noose in my pocket, and went quietly to the place. He was not there.

Now I have always preached that each wild animal has a home-region and a routine of life, just as men have. To this rule the Quill-pig is no exception. One time he is in this den, another time in that; this day, he is eating lily-pads at the pond, next day, he is feeding on twigs of the hemlock grove. The home range of the Porky is small; without doubt, this creature was within a quarter of a mile of me at this moment. So I set about to find him.

The tracks and signs told me that he most often went southeastward from the barrel toward a hemlock ridge. I went cautiously in that direction, not following any one track; but noting with satisfaction that there were plenty of signs. Every few minutes, I paused and listened. At last, I heard a patter on the leaves. I was ready with a forked stick and a noose, and rushed forward. I surprised the Quilly One, turned him over, and noosed his hind foot before he could make for tree or hole.

When I picked him up, I judged his weight to be about six pounds; but before I had carried him at arm's length a quarter of a mile into an opening, unquestionably he weighed fully fifty-six pounds.

Of course, he began by lashing his foot full of spines; then he furnished me with some illustrations of his inverted drill manual, as follows:

On guard (which is turn tail and jam your head under a root).
Charge (which is backward).
Retreat (which is forward).
Thrust (which is a circular sweep).
Parry (which is an upper cut).

My intentions toward that Porky were quite honourable, but he treated me like a pickpocket or a highwayman. I think that he expended over a hundred darts in his attempt to repel me; and, of these, over twenty were in his own hind foot, of course.

The final thankless ceremony was dequilling the foot of the spiny one. He loved me not—before, during, or after the operation. As he waddled off into his hemlocks, I wondered if nature had provided him with some means of his own for resisting or extracting the poisoned shafts; a plan by which he might have helped himself, had I let him go without attempting the dangerous operation of removing the quills.

Another time, my guide and I went to a small lake called Gal-pond. While sitting on the bank, we heard a patter on the leaves behind us. Dobson whispered, "Hedgehog!" We ran toward it; but the creature, a large, old fellow, made for a tree;" and in spite of forked sticks, succeeded in climbing out of reach, and out of view so far as the camera was concerned. I was for climbing after him, he was so obviously cornered; surely I could get some pictures up there. But Dobson said he had several times heard of such things, and once had seen a man climb after a Porky. It was a scene and a lesson never to be forgotten. As soon as the knight of many spears saw his enemy approaching him high in the tree, he backed down toward him, lashing that death-dealing tail of his. Unable to get down fast enough, and in imminent danger of a serious fall, the man threw up his arm to protect his face; and the quills on that fearsome tail speared it in fifty places. A hurried, horrid scramble to the ground was all that saved the man from still more dreadful punishment. But he had not by any means escaped a very full measure of the Quill-pig's wrath. Blood-poisoning set in, and for weeks, the arm was useless; at one time, it was feared that amputation would be necessary. It was several months before the man fully recovered from the vengeance of Old Quills.

So, good-bye, Quills; far be it from me to intrude.

REFERENCES

1795—A Journey to the Northern Ocean, by Samuel Hearne, pp. 381–82.

1849—Quadrupeds of North America, by Audubon and Bachman, I, pp. 277–86; 1 ill.

1884—Mammals of the Adirondacks, by C. Hart Merriam, pp. 300–05.

1898—Western Porcupine, *Erethizon epixanthus*, by Allan Brooks, *Recreation*, Nov., pp. 343–44; 3 ills.

1927—Notes on the Porcupine, by Parke H. Struthers, Syracuse Univ., advance sheets of his unpublished monograph.

LIFE XCI—THE CONEY

PAGE
Names 636
Description: Size, Colour 637
Races 637
Range and Haunts 638
Numbers and Migration 638
His Way of Life 640
The Bump of Moss That Squeaks 640
His Personality 641
The Hay-barn 641
The Weatherwise Coney 643
Winter Life 644
Young. 644
Foes of the Little Chief 644
His Safety Is in the Rocks 646

References 646

Coney, Calling Hare, Squeak-rabbit, Rock-rabbit, Starved Rat, Little Chief Hare, Pika, Ochotona, Slide-rat, Hay-maker, Mouse-hare

Ochotona princeps (Richardson)

(*Ochotona*, latinized from the Mongol name of the creature, *Ochodona*; L. *princeps*, chief)

Lepus (*Lagomys*) *princeps* RICHARDSON, 1828, Zool. Journ., III, p. 520.
[*Ochotona*] *princeps* TROUESSART, 1897, Catal. Mamm. viv. foss., p. 648.

TYPE LOCALITY—Head of Athabaska River, Alta.

Richardson mentions[1] that the Chipewyan Indian name for the Coney is *Bucka-thrae Kah-yawzae*, meaning "Little Chief Hare." In this, we recognize the familiar *Kah*, a Hare; *yazzi*, diminutive; while *Chief* is given by Alexander Mackenzie[2] as *Buchahudry*. The specific name is a latinization of this.

The Family *Ochotonidæ* is, so far as America is concerned, represented by the genus *Ochotona*. For our present purposes, therefore, the Family and generic characters are the same.

The genus *Ochotona* (Link, 1795), of which the present is the type, are small animals, each the size of a half-grown Rabbit, but presenting a combination of Mouse and Rabbit characters. The teeth are, in some respects mouselike; the general form is rabbitlike. The external tail is wholly absent, which is a Rabbit feature pushed to the limit. The molars are rootless, as in some Mice. The soles of the feet are hairy, which is rabbitlike. The ears are round, and short, which is mouselike. And it squeaks continually, which is a way of its own.

The teeth are:

$$\text{Inc. } \frac{2-2}{1-1};\ \text{prem. } \frac{3-3}{2-2};\ \text{mol. } \frac{2-2}{3-3} = 26$$

Taking Arthur H. Howell's Revision as our starting point, there are three species of Pika in North America:

(1) The Rocky Mountain form (*princeps*), a warm brownish-gray creature with buffy underparts and broad palatal bridge (2.3 mm).

---

[1] F. B. A., I, p. 227.

[2] Voyages from Montreal, 1801, p. cxxxii.

(2) The Slatey-crowned Pika (*schisticeps*), of the southwestern mountains; much like *princeps*, but with a slate-coloured head and narrow palatal bridge (1.6 mm.)

(3) The Alaska or Collared Pika (*collaris*). This is a gray creature with the underparts creamy white without any buffy wash; and an indistinct grayish collar on the shoulders.

The Coney of the Rocky Mountains combines the generic characters with the following specific details:

Size. Length, $7\frac{1}{2}$ in. (190 mm.); tail, 0; hind foot, $1\frac{1}{4}$ in. (32 mm.). The female is a little smaller.

Colour. In general, it looks much like a Packrat; that is, it is all over of a soft, woody brown, finely peppered or lined with dark hair-tips, especially on the central part of the lower back. The brown becomes deeper and more yellowish along cheeks and flanks. All below, including the feet, is whitish, with yellowish brown, and varied with the dark leaden underfur showing through. The face is like the back, but browner. The ears are blackish, with dull white rims.

In winter, the general colour is more gray.

The sexes are alike.

RACES

It is found in 16 well-marked races, as follows:

princeps Richardson, the typical form. T. l., Headwater of the Athabaska River.

lutescens Howell, like *princeps*, but smaller and much paler. T. l., Mt. Inglesmaldie, near Banff, Alta.

levis Hollister, smaller and paler than *princeps;* like *lutescens*, but darker and buffier. T. l., Chief Mt. Lake, Alta.

lemhi Howell, like *princeps*, but smaller and very pale. T. l., Lemhi Mts., Ida.

ventorum Howell, like *princeps*, but paler and more buffy; with larger skull. T. l., Fremont Peak, Wyo.

uinta Hollister, like *ventorum*, but much more buffy, especially in summer. T. l., Uinta Mts., Utah.

nevadensis Howell, like *uinta*, but paler. T. l., Ruby Mts., Nev.

figginsi Allen, like *uinta*, but more grayish, less buffy, and more varied with blackish. T. l., Pagoda Peak, Colo.

saxatilis Bangs, much like *figginsi*, but paler and less vinaceous; like *ventorum*, but sides ochraceous-buff instead of pinkish cinnamon; underparts buffy; more gray than *uinta.* T. l., Montgomery, Park Co., Colo.

incana Howell, much like *saxatilis,* but paler and less tawny. T. l., Pecos Baldy, N. M.

nigrescens Bailey, like *saxatilis,* but darker and more grayish; less brownish than *figginsi;* skull smaller than in *saxatilis.* T. l., Jemez Mts., N. M.

cuppes Bangs, like *princeps,* but darker; ochraceous-tawny above instead of cinnamon-buff; pinkish cinnamon below instead of pinkish buff. T. l., Monashee Divide, Gold Range, B. C.

fenisex Osgood, similar to *cuppes,* but paler and grayer; skull smaller. T. l., Ptarmigan Hill, head of Ashnola River, Cascade Range, B. C.

brooksi Howell, like *brunnescens,* but in winter, more cinnamon on head; more vinaceous in general; in summer, paler, more brownish than *fenisex.* T. l., Sicamous, B. C.

brunnescens Howell, similar to *fenisex,* but much more brownish above, and more buffy below. T. l., Keechelus, Kittatas Co., Wash.

fumosa Howell, size of *brunnescens,* with narrow skull; less brownish and more blackish above. T. l., Permilia Lake, Mt. Jefferson, Ore.

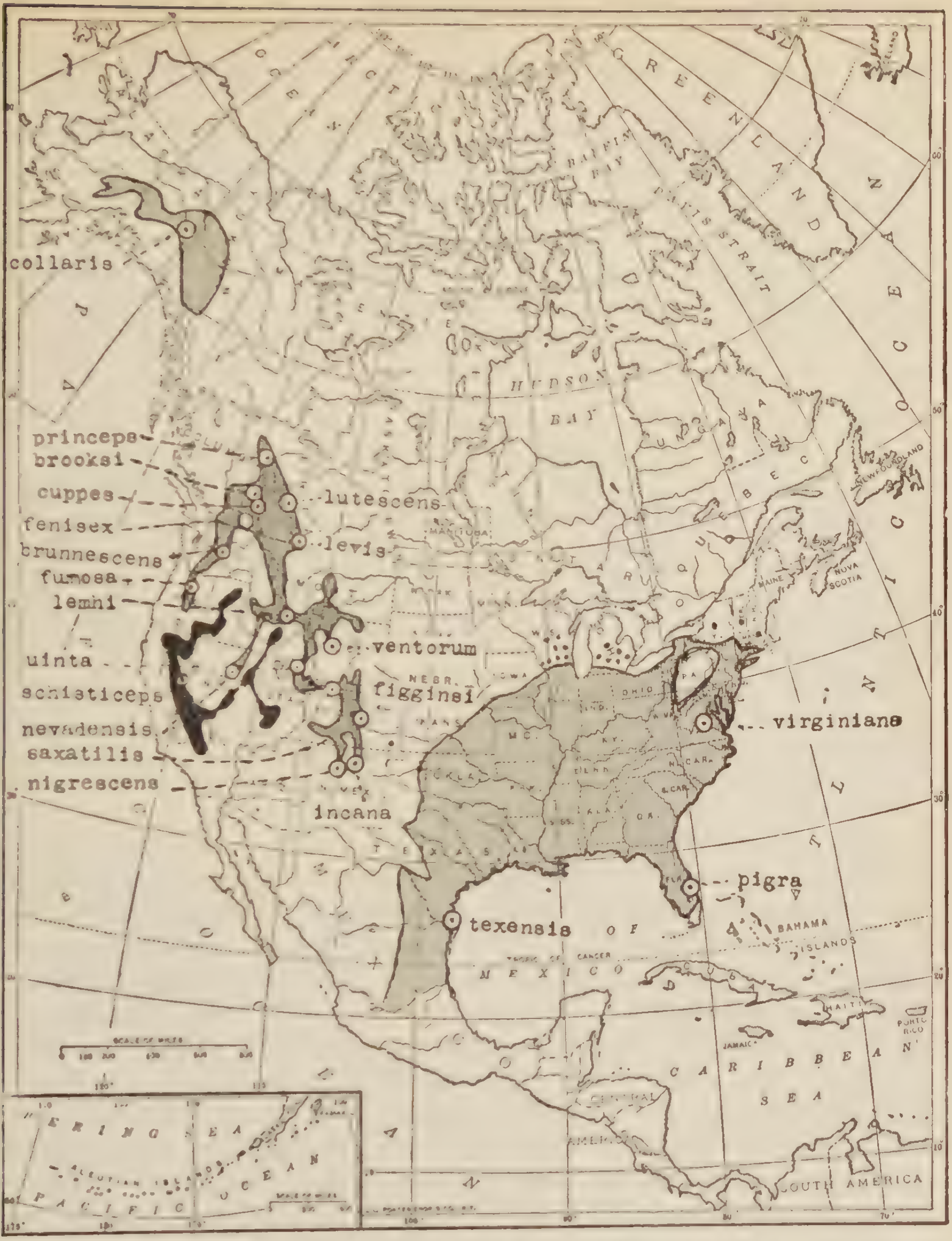
Range and Haunts

Map XVII (p. 639) shows that the Coney range includes an immense stretch of the mountains. Careful investigation indicates that, in the aggregate, the species really possesses but little of that stretch, being confined to certain small and narrow areas high up near timber line. These are great, open, rugged slopes—so rough, bleak, and inhospitable that there be almost no competitors in fur for possession of them; they are invariably slides of broken, tumbled rocks.

Numbers and Migration

My own travels have made me familiar with the high mountains from central Colorado to central British Columbia; and within this, I have never yet seen slide-rock up near timber-line without finding the little bump that squeak—squeak—squeaks from some low point of rock. About Pagoda Peak, Colo., I found them abundant in every rock-slide, Sept., 1901.

We have no satisfactory means of gauging their numbers. They must be less numerous than Mice, and more plentiful than Weasels; and the im-



MAP XVII.—RANGE OF THE 3 SPECIES OF CONEY AND OF THE POSSUM

By E. T. Seton, with assistance of the Biological Survey, 1927

O. princeps in the Rocky Mountains and Coast Ranges of Washington and Oregon; *O. collaris* in Yukon and Alaska, and *O. schisticeps* chiefly in California, Nevada, and Western region.

Range of the *Possum*. The California records are not entered, the spots in Colorado, Wisconsin, Michigan, New York, and New England are recent records.

mensity of the accredited range should be promise that they exist in millions.

We have a little light on their method of dispersal when the old rock-slide grows too tame or too congested for the young hopefuls. "During October of each year," says Anthony, "I have met with a few Picas a mile or more from the slides. A pair which took up a winter residence in a slab pile at my camp on East Eagle Creek, were about 2 miles from the nearest colony, and fully 1,500 feet lower in altitude."[3]

His Way of Life

No matter how horrible a certain climate or condition may seem to us, it is sure to be the ideal of some wild creature, its very dream of bliss. I suppose that slide-rock, away up in the cold, bleak, windy country above the timber-line, is absolutely the unloveliest landscape, the most repulsive home ground that a man could find in the mountains; and yet it is the paradise, the perfect place, of the Coney or Calling Hare. So that this wonderful little creature is found on the high peaks of the Rockies from California to Alaska.

His race is not especially abundant in the Yellowstone Park, but it was there that first I made his acquaintance; and Easterners will meet with him in the great Reserve more often than in all other parts of his range put together.

The Bump of Moss That Squeaks

As one reaches the Golden Gate, near Mammoth Hot Springs, Yellowstone Park, many little animals of the Ground-squirrel group are seen running about with occasional chirps and chatters. From the distance, comes a peculiar cry, a short squeak uttered every ten or fifteen seconds—"*e-week, e-week*." You stop, perhaps search with your eye the remote hillside; but you are looking too far afield. Glance toward the tumbled rock piles, look at every high point. There on top of one, you note a little gray lump, like a bump of moss, the size of your fist, clinging to the point of the rock. Fix your glasses on it, and you will see plainly that the squeak is made by this tiny creature, like a month-old Rabbit, with short, round, white-rimmed ears, and no visible tail. This is the curious little animal that cannot be happy anywhere but in the slide-rock; this is the Calling Hare.

The driver calls it "Coney," or "Rock-rabbit"; and the old miners will tell you it is a "Starved Rat."

In colour, size, shape, and habits, he differs from all other creatures in the region; it is impossible to mistake him. Though a distant kinsman of the Rabbits, he is unlike them in looks and ways. Thus, he has, as noted, the very unrabbitlike habit of squeaking from some high lookout.

---

[3] Periodical Emigrations of Mammals, Journ. Mamm., Feb., 1923, p. 60.

The squeak is doubtless a call of alarm to let the rest of the company know that there is danger about, for the Coney is a gregarious creature; there may be a hundred of the tribe in the rock-slide.

Some years ago, in Colorado, I sketched one of the Coneys by help of a field glass. He was putting all the force of his energetic little soul into the utterance of an alarm cry for the benefit of his people. The portrait appears on Plate LXXXI (p. 645).

His Personality

All of these habits are as unrabbitlike as may be; and scientists now even decline to refer the Coney to the Rabbit family as they formerly did.

Yet he has tokens of Rabbit kinship. As the California naturalists say: "When a Cony comes to 'attention' on an observation post, the head is often raised, the nose wiggled, and the feet 'shuffled,' all suggestive of mannerisms of a Rabbit; but the movements of the head are much quicker. The hobbly gait reminds one somewhat of the hopping of the Brush-rabbit. The Cony moves rapidly and with apparent ease, almost everywhere in a slide; even over very steep and smooth rock surfaces. We have never seen one of these animals assume the erect posture which is common to Rabbits."[4]

Florence Merriam Bailey offers an interesting glimpse of Coney life and manners, thus: "While the provident Conies of the rock-slide were gathering stores, others were taking their ease, coming up from the dark hollows between the rocks to sun themselves in characteristic statuesque attitudes—some with heads up, some squatting, with ears folded down like those of a frightened Rabbit; while one was seen washing its face with its paws like a kitten."[5]

His Hay-barn

But the most interesting habit of this unrabbity Rabbit is his way of preparing for winter.

When the grass, the mountain dandelions, and the peavines are at their best growth for making hay, the Coney, with his kind, goes warily from his stronghold in the rocks to the nearest stretch of herbage, and there cuts as much as he can carry of the richest growths. Then, laden with a bundle as high as himself, and very much longer, he makes for the rocks; and on some flat open place, spreads the herbage out to be cured for his winter hay. Out in full blaze of the sun he leaves it; and if some inconsiderate rock come in between, to cast a shadow on his hay a-curing, he moves the one of these that is easier to move; but he never neglects his hay.

---

[4] The Yosemite Cony, Grinnell & Storer, Sierra Club Bulletin, Vol. X, No. 2, 1917, p. 163.

[5] Forest & Stream, April 8, 1911, p. 531.

When dry enough to be safe, he packs it away into his barn. This barn is a sheltered crevice in the rocks where the weather cannot harm the hay; and where it will continue good until the winter time, when otherwise there would be a sad pinch of famine in the Coney world. The trappers say that they can tell whether the winter will be hard or open by the amount of food stored up in the Coney barns. Which is simply a new form of the old and pleasing myth about the thickness of the fur presaging the hardness of the coming winter.

Many a one of these barns I have examined in the mountains of British Columbia and of Colorado, as well as in the Yellowstone Park. The quantity of hay in them varies from what might fill a peck measure to what would make a huge armful.

Among the food plants used, I found many species of grass, thistle, meadow-rue, pea-vine, heath, and the leaves of several composite plants. I suspect that fuller observations will show that they use every herb not actually poisonous, that grows in the vicinity of their citadel.

More than one of these wads of hay had in the middle of it, a nest or hollow—probably not the home nest where the young are raised, but a sort of winter restaurant whither they could repair while the ground was covered with snow; and, sitting in the midst of their provisions, eat to their hearts' content. It is not unlikely that in this we see the growth of the storage habit, beginning first with a warm nest of hay, which it was found could be utilized for food when none other was available.

The fact that these barns are used year after year is shown by the abundance of pellets in several layers which were found in and about them.

A pleasing picture of Coney-town in New Mexico, during harvest time, is offered by Florence M. Bailey. She was seated on a Coney-haunted slide, camera and notebook at hand, and relates:

"One of the small haymakers was hurrying back and forth, hard at work. Going to one especial place in the weeds outside of the slide, he would pick a green bouquet, and, carrying it in his mouth, run back to his haystack under the rock.

"Once, when carrying a load too big to see over, he ran plump against the foot of the photographer, frightening himself so that he scampered off and hid away in his cave.

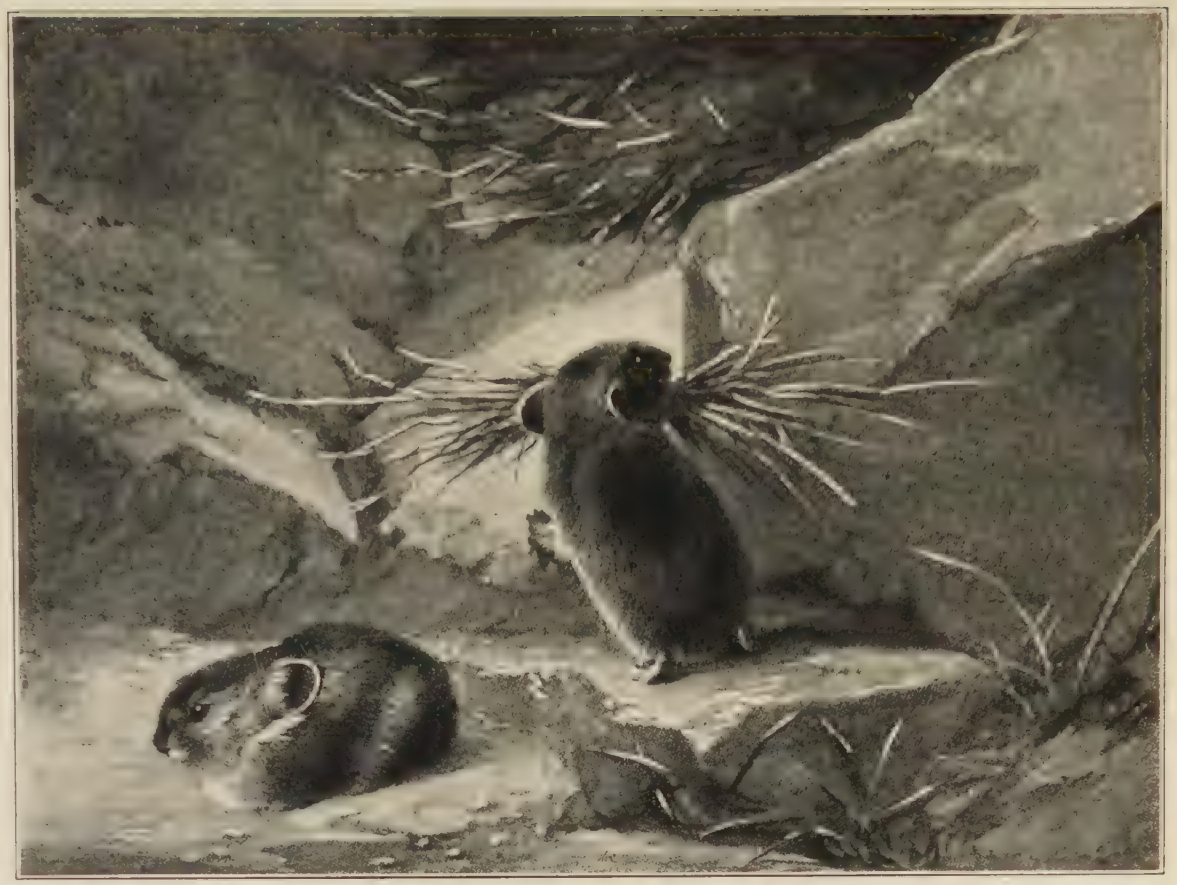


PLATE LXXIX.—CONIES AND THEIR HAY

From drawing by E. T. Seton

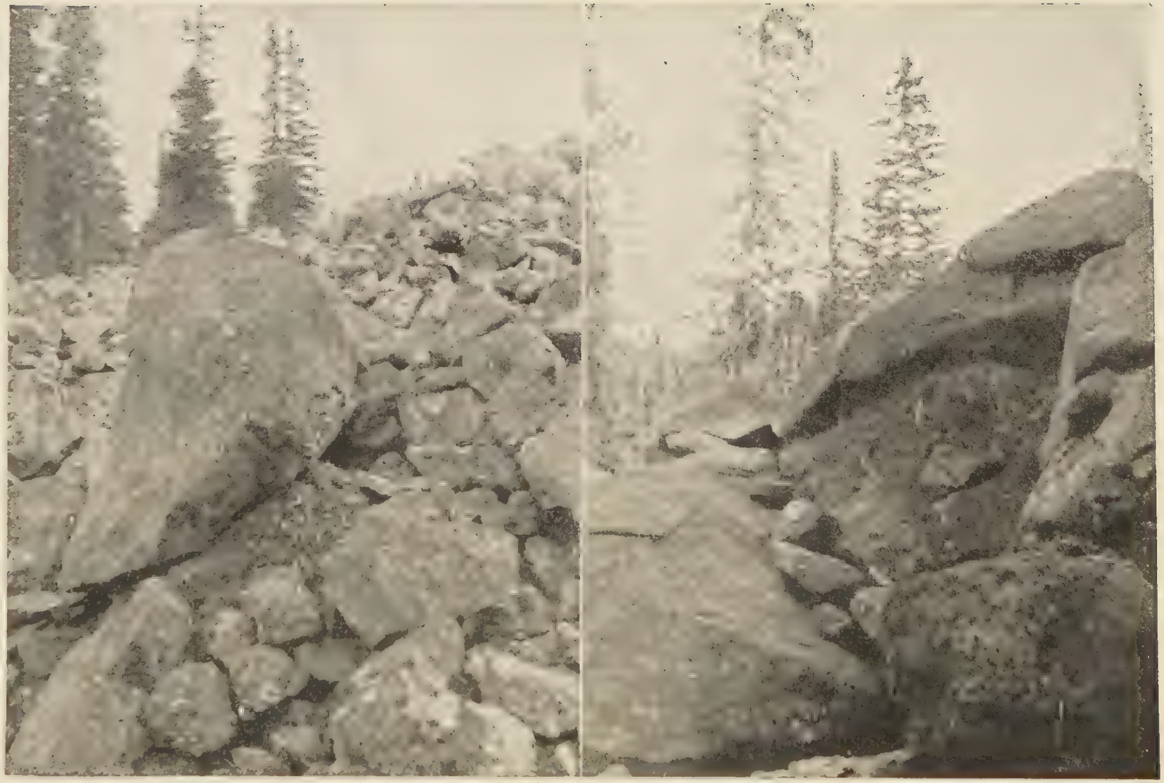


PLATE LXXX.—CONEY HAYBARNS

Photograph by E. T. Seton

"Another haymaker that I watched, an old one with brown fur, worked as if the cold storm had convinced him that winter was upon him. Unlike his systematic fellow who went and came to the same spots, he ran out into the weeds wherever the notion took him, and dumped his load of hay under a number of different stones, scattered about his end of the slide. He brought a variety of material—old brown leaves, fresh green grass, a bunch of asters, and once such a big bunch of cow parsnip that it was a wonder he wasn't tripped up by it. When he was photographed—at 10 feet, for he was apparently fearless—he was sitting on a rock with his mouth full of hay, a daisy sticking up from one corner like an Irishman's pipe. While resting between loads, at my insistent call, 'Go to work, Coney, go to work,' he would start off for his hay on a trot, perhaps startled by the voice, perhaps influenced by the urgency of the tone, which probably accorded with his meteorological observations."[6]

THE WEATHERWISE CONEY

A very wise little folk is this people of the rocks. Not only do they realize that, in summer, they must prepare for winter, but they know how to face a present crisis, however unexpected. To appreciate the following instance, we must remember that the central thought in the Coney's life is his "grub pile" for winter use; and next, that he is a strictly daytime animal. I have often slept near a Coney settlement, and never heard a sound or seen a sign of their being about after dark.

Nevertheless, Merriam tells us[7] that he and Vernon Bailey once carried their blankets up to a Coney colony above timber-line, in the Salmon River Mountains of Idaho, intending to spend the night there, and to study the Coneys, whose piles of hay were visible in all directions on their rocks. As this was about the first of September, it was natural to expect fair weather and a complete curing of the hay in a week or so. But a fierce storm set in with the descending night. The rain changed to hail, and then to snow; and, much to the surprise of the naturalists, they heard the squeak of the Coneys all night long.

These animals love the sunshine, the warmth, and the daylight, and dread cold and darkness as much as we do. It must have been a bitter experience when, at the call of the older ones, every little Coney had to tumble out of his warm bed in the chill, black hours, and face the driving sleet to save the winter's supplies. But tumble out they did; and overtime they worked, hard and well. When the morning dawned, the slide-rock and the whole world was covered deep in snow, but every haycock had been removed to a safe place under the rocks; and the wisdom of the Coney once more exemplified, with adequate energy to make it effective.

---

[6] Forest & Stream, April 8, 1911, p. 530.

[7] N. A. F., 5, 1891, p. 74.

WINTER LIFE

Bailey says: "Nothing is known of the habits of these animals in winter when they and their haystacks are buried deep under the snow, except that, in the spring, the haystacks are found reduced to a few dry sticks and stems, and the Ochotonas seem to have survived the Arctic winter in good condition."[8]

That they are active all the year, is evidenced by the following from M. P. Skinner, concerning the Coney-town at Golden Gate, Yellowstone Park: "I have seen them out repeatedly on mild winter days; and on Feb. 7, 1921, they were out on a bright, sunny morning when the temperature was actually far below zero Fahrenheit."[9]

YOUNG

About all the light we have on the young of the species, is supplied by A. Brazier Howell, who says, concerning the Coney in Mono County, Calif.: "On July 20 . . . I shot from her favourite rock a female containing 3 rather large embryos; and two days later, a half-grown young from the same perch. This slide is too circumscribed to support more than a single family, so it appears that two litters are produced each year, at least, in some cases."[10]

FOES OF THE LITTLE CHIEF

There is no flesh-eater that would not gladly eat the Squeaker; but the massive bulwarks of his mountain home defy all who would dig him out. Two classes only can secure his poor, thin body for their meal—the hawks who swoop swiftly round the mountain side, and snatch him from his rocky perch before he knows he is assailed; and the Weasels, thin, sinuous, persistent, that follow to his farthest hiding place. The fieldmen generally consider the chief and only dangerous enemies of the Hare are the Weasels,—Long-tailed, Short-tailed and Marten,—that seek him out, and slay him in his secret chamber. What offset he has devised for their onset, I do not know.

---

[8] Science, New Series, XXV, Feb. 22, 1901, p. 307.

[9] Journ. Mamm., Aug., 1925, p. 202.

[10] Mamm. of Mammoth, Mono Co., Calif., Journ. Mamm., Feb., 1924, p. 35.

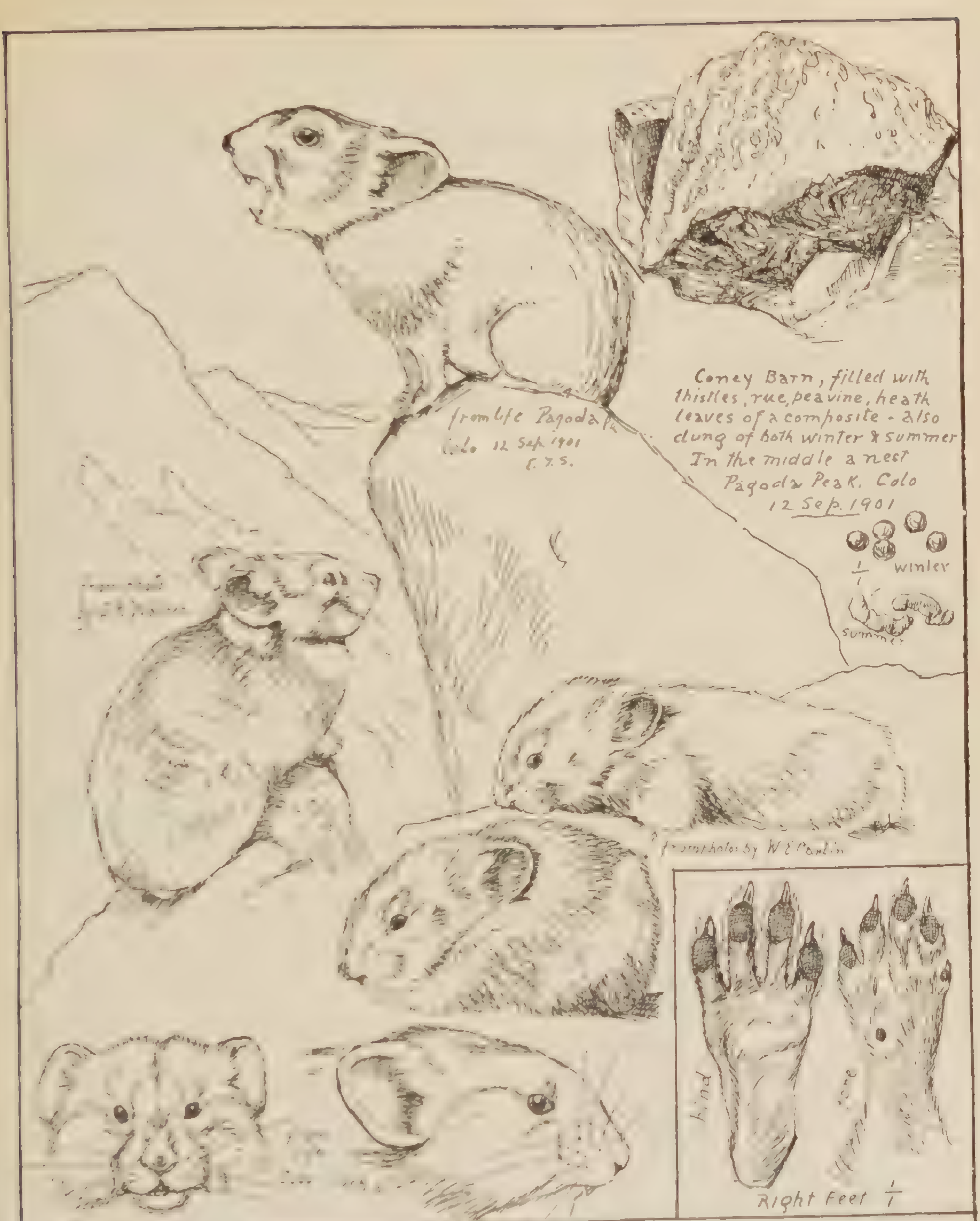


Plate LXXXI. Attitudes & Details of Coneys by E T Seton

His Safety Is in the Rocks

No man has ever yet found the home nest of the Calling Hare. It is so securely hidden under rocks, and in galleries below rocks, that all attempts to dig it out have thus far failed. I know of several men, not to mention Bears, Badgers, Wolverines, and Grizzlies, who have essayed to unearth the secret of the Coney's inner life.

Following on the trail of a Coney that bleated derisively at me near Pagoda Peak, Colo., I began at once to roll rocks aside in an effort to follow him home to his den. The farther I went, the less satisfaction I found. The uncertain trail ramified more and more as I laboured. Once or twice from far below me, I heard a mocking squeak that spurred me on; but, at long length, that, too, ceased.

When about ten tons of rock had been removed, I was baffled. There were half a dozen possible lines of continuation, and while I paused to wipe the "honest sweat" from my well-meaning brow, I heard behind me the "*weak*, *weak*," of my friend, as though giving his estimate of my resolution. Then I descried him—I suppose it was the same Coney—on a rock point, like a moss-bump against the sky-line away to the left. Only one end of the moss-bump moved a little each time a squeak was cast upon the air. I had not time to tear down the whole mountain, so I did as my betters, the Bears and Badgers, have done before me—I gave it up. I had, at least, found out why the Coney avoids the pleasant prairie and the fertile banks; and I finished with a new and profounder understanding of the Scripture text which says in effect: "As for the Coney, his safe refuge is in the rocks."

References

1924--Revision of the American Pikas, by Arthur H. Howell, *N. A. F.*, pp. 47, 57; 6 plates, 4 maps.

The Night alarm

LIFE XCII—PRAIRIE-HARE

PAGE
Names 648
Description: Size, Weight, Colour, Ears 648
Races 650
Range and Invasion of Manitoba 650
Introductions 651
Haunts and Home Range 652
Number and Migrations 653
As a Freezer 653
Food 654
Unsociable and Uncommunicative 654
Mating Standards Loose 656
Nesting and Young 656
Speed 657
A Swimmer 658
His Foes and His Safety 660
Diseases 662
His Tale of Years 663
Jack in the Landscape 664
Worth to Us 665

References 665

The European Hare—An Introduction 665

Prairie-hare, Meadow-hare, Rocky Mountain Hare, Mountain Hare, Townsend's Hare, Whitetailed Jackrabbit, or White-jack

Lepus townsendii Bachman

(L. *Lepus*, a Hare; *townsendii*, in honour of J. K. Townsend, who collected the type specimen)

Lepus townsendii Bachman, 1837, Jour. Ac. Nat. Sci. Phila., VIII, Pt. I, p. 90, pl. 2.

Type Locality—Fort Walla Walla, Wash.

French Canadian, *le Lièvre.*
Ojibway, *Kit-chee-Wah-boos'* (big white Rabbit).
Yankton Sioux, *Mah-steen-cha Tung-ka.*
Ogallala Sioux, *Mahs-tin-shkah.*
Cree, *Mis-tah-boos'* (big white Rabbit).

The Family *Leporidæ* comprises large terrestrial rodents which have soft, dense fur, very long ears, long hind legs, short, bushy tail, and a remarkable duplication of the upper incisors—that is, behind the usual 2 in front of the upper jaw, is a rudimentary pair.

The genus *Lepus* (Linnæus, 1758) comprises rabbitlike animals of large size, covered with soft fur and underwool, never definitely spotted or striped. The northern species turn pure white in winter. They have long ears and legs; tail, medium or short; interior of mouth and soles of feet, hairy; fore feet with 5 toes, hind with 4; mammæ, 6 to 10.

Teeth:

$$\text{Inc. } \frac{2-2}{1-1}; \text{ can. } \frac{0-0}{0-0}; \text{ mol. } \frac{6-6}{5-5} = 28$$

With these generic characters, the Prairie-hare combines the following:

Size. A male from Asotin, Wash., taken Sept. 11, 1895 (No. 74840, Biol. Surv.): Length, 22½ in. (571 mm.); tail, 3 in. (76 mm.); hind foot, 5⅞ in. (149 mm.).

The specimen from which the drawing was made (Plate LXXXII, p. 650 was a representative female from Boissevain, Man., collected by A. S. Barton, Sept. 27, 1904. It is 2 feet (610 mm.) from nose tip to root of tail; the tail to tip of bone is about 4 in. (101 mm.). The hind foot, heel to end of longest claw, is 6 in. (152 mm.).

Weight. An adult specimen which I got at Carberry, Man., weighed only 6 lbs: A female shot at Gardiner, Mont., Aug. 16, 1897, was in milk; she weighed 7¼ lbs. Charles W. Nash records that he saw one at Mountain City, Man., that weighed 8 lbs. Dr. Sam J. Thompson, of Carberry, Man., shot a large one in his garden, and found that it weighed 11 lbs. Francis Dickey, of Carberry, tells me that, on Oct. 8, 1905, he shot a very large one that turned the scale at 12 lbs. These, doubtless, represent extreme weights; 7 or 8 lbs. is about average.

Colour. This animal is in general appearance, a silvery gray Hare, with white tail and underparts.

In detail the whole of the head and body above, as well as chest and legs, is of a soft, warm gray, thickly speckled or peppered with blackish brown, which is the middle part of each long hair showing through. Around the eye is a whitish ring. On the ears, the peppering is very fine. The ear behind, is velvety, snowy white, with black tip-spots, which is 1½ in. long, and ¼ in. at the widest. The chin, breast, belly, and inside of the legs is snowy white. The tail is pure white, with a narrow band of dark gray on top. The foot bristles are dull yellowish.

A winter (Jan. 23) specimen from British Columbia (*Lake Osoyoos*) is similar, but of a paler, cooler gray above—a silvery gray.

In both, the nursery fringe is well marked, and there is a brown stain on the knees.

In the large series in the Biological Survey collection, there is not a winter specimen which is pure white. The nearest—a male from Salmon, Ida., Nov. 26, 1916—has the head above, ears, and fore paws softly silvered on the usual brownish gray, so as to look nearly white; all the rest, including tail, pure white.

In summer pelage (May and July), specimens from North Dakota resemble those from Idaho and Washington, but more tinged with buffy. All of *campanius* have the tail pure white above at all times; no stripe. In winter, they are pure white, except the head and ears, which continue gray.

The Prairie-hare is very pale compared with other Hares in summer coat, but its conspicuous label mark is the bushy *tail of pure white*. As it bounds away, this is held, not downward like that of a Texas Jack, or against his back like that of a Cottontail or a Snowshoe Rabbit, but straight out behind, or switched from side to side, like the white flag of a Whitetailed Deer. By this, and its size, the Prairie-hare may be known at all times.

Ears. Why has the Jackrabbit developed such ears? Not for hearing, I suspect. The plains animals are less in need of hearing gear than the wood creatures. It is very clear what its long legs were made for, and it is possible that the general demand for increased extremities was indiscriminately applied, resulting in a beneficial lengthening of its four important outliers, and a fortuitous development of tail and ears.

The only use I can see for the additional ear-flaps is as a sort of roof when it squats in its form during hard rains. They cover its back like two long leather shingles, or a pair of empty gloves; and may ward off many an attack of pneumonia, etc. Their position when the owner squats, is exactly like that of a seaman's or fireman's hat, and similarly may serve to keep the floods from pouring down the back of the wearer's neck.

Races

The three recognized races are:

- *townsendii* Bachman, the typical form. T. l., Fort Walla Walla, Wash.
- *campanius* Hollister, a large form, found in the rich prairies; darker and richer in colour than *townsendii*, with larger black spots on ears; tail, pure white above and below at all times. T. l., Carlton House, Sask.
- *sierræ* Merriam, from the Sierra, the largest of all; darker than *townsendii*, and much browner; paler than *campanius*, with much black on ears. T. l., Hope Valley, Alpine Co., Calif.

Range and Invasion of Manitoba

This, the largest of the Hares in Temperate North America, is exceeded in size by some of the Arctic and subarctic species only. It has a wide distribution on prairies, plains, mountains, and in forests of the Northwest, apparently influenced by little but climate.

In Manitoba, it is now found on all prairies, but it seems to have been unknown in the early days, although Richardson gives[1] it a general range that includes the southwestern part of the Province.

Alexander Henry, in his voluminous notes on the creatures of Red River Valley (1799 to 1814) did not record it for Manitoba, and but once for North Dakota, as follows:

On Oct. 21, 1804,[2] while mounted on his "famous gray Horse," and hunting near the junction of Pembina and Red Rivers in Dakota, he "started a large Meadow-hare, and killed it only after a long chase, as they are very swift."

---

[1] F. B. A., I, 1829, p. 224.

[2] Journal, p. 251.

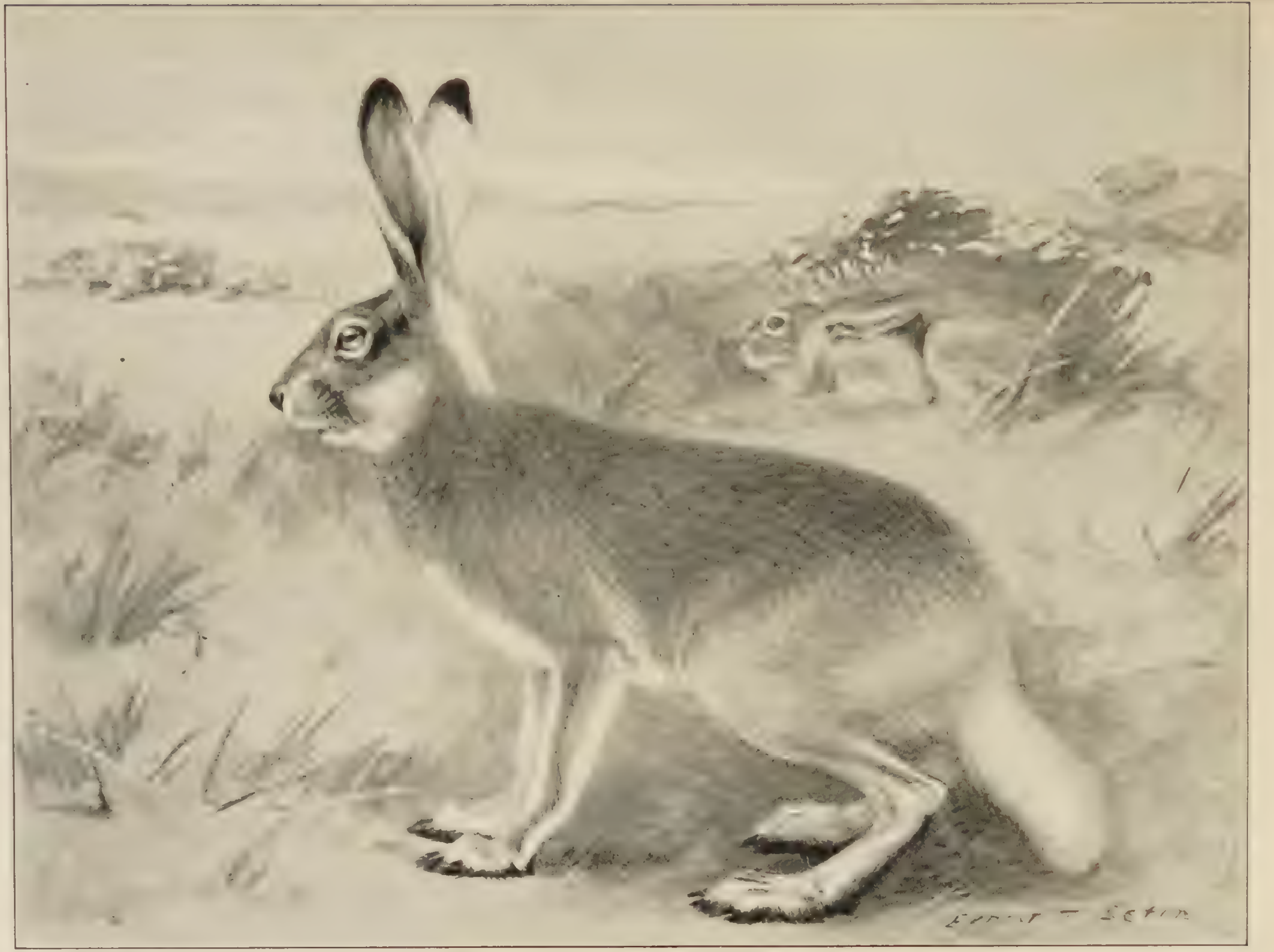


PLATE LXXXII.—PRAIRIE-HARE

(*Lepus campestris* Bachman)
A female specimen taken at Boissevain, Manitoba, September 27, 1904

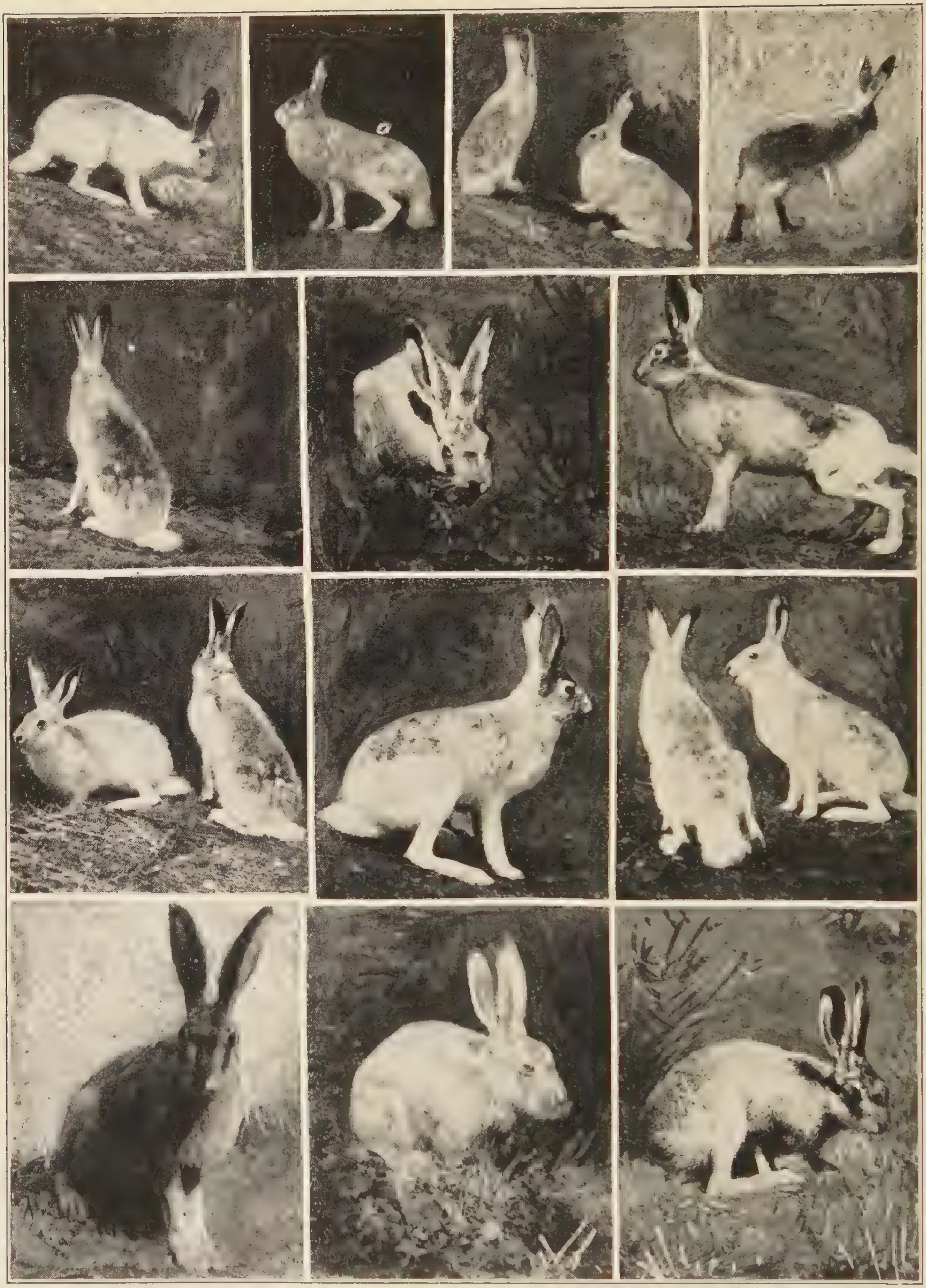


PLATE LXXXV.—PRAIRIE-HARE POSES

Photos. by E. T. Seton

Kennicott, the naturalist, who searched the Red River Valley for small animals about 1856, did not meet with it. Professor H. Y. Hind explored all the Manitoban prairies in 1858-59, without finding one. J. H. Cadham, who came to Winnipeg in 1870, tells me that it was then unknown in Manitoba. Dr. Elliott Coues, in 1873, collected birds and quadrupeds all along the southern boundary of Canada, from Pembina westward, and did not meet with the Prairie-hare till he got on the Côteau du Missouri, or over 50 miles west of the Manitoban line.[3] In 1882, I travelled all summer on the Plains of the Souris, from Pembina River west to Turtle Mountain, and southwest from Brandon; and from Carberry over the northwest country toward Fort Pelly, without seeing or hearing of a Prairie-hare. In 1883–84, I camped over the prairies north and east of the Assiniboine, and still met with none but the common American Wood-hare. But in Sept., 1883, Miller Christy saw a Prairie-hare just west of Fort Ellice; and in 1885, George F. Guernsey reported it common at Fort Qu'Appelle.

A. S. Barton, of Boissevain, writes me: "The first Jack I ever heard of here was in 1881; since then, they have increased." C. W. Nash saw one killed at Mountain City in March, 1887.

On Aug. 26, 1892, I collected a specimen at Carberry. This was the first record for Manitoba north of the Assiniboine; none of the residents had ever seen one before. In 1894, Dr. S. J. Thompson tells me, they became common at Carberry; and in 1897–98, were so plentiful that one could see 15 or 20 in a mile drive. About Napinka, especially, they had become extremely numerous in 1898; and were proportionately destructive to the crops. They now abound in all the rolling prairie region of the Province.

J. H. Cadham, after 35 years' residence in Manitoba, tells me that the first he ever saw was near Winnipeg in 1896; in 1898, the species was seen for the first time at a place 6 miles west of Stony Mountain. Farmers who had lived there 15 years, had never seen one before. The species has steadily increased, and is now found in all the prairie country east of Red River, but not north of Winnipeg yet on the east side of the river. The united testimony of witnesses is that this Jackrabbit is now found in all the open regions of the Province, that it has continually advanced from the southwest, and is now generally abundant.

INTRODUCTIONS

At Fayette, Ia., on Feb. 27, 1905, I met Thomas L. Green, the postmaster, a well-known old-timer, who assured me that Jackrabbits were unknown there 20 years before; but that about 1890 or 1895, they came in, and now were plentiful.

---

[3] Field Notes, 49th Parall., 1878, Geol. Surv. Bull. 3, Vol. IV. p. 457.

When at Lake Mashipecong, N. J., on June 12, 1920, I gathered the testimony of a number of old residents and native sportsmen, who informed me that Whitetailed Jacks had been introduced from the West, and were now found in the open fields.

In the Journal of Mammalogy[4] is a note from Dr. Hartley Jackson, recording the fact that the species has been introduced into Wisconsin.

About 20 years ago, I tried to introduce the Whitetail in Greenwich, Conn.; but none survived the second year.

HAUNTS AND HOME RANGE

Although called Prairie-hare, I have seen this species in the pine forests of California, and high up among the Rocky Mountains of Wyoming and Montana, as well as on the sage deserts. It is, indeed, less strictly a "prairie" Hare than many of its relatives; and I note with interest that in some parts of Manitoba, it is called "Mountain-hare." The prairie with scattering low cover is, nevertheless, its favourite haunts, and it shows also a remarkable partiality for the ploughed parts. In such footing the Hare is very much at home, though most running animals find it a disadvantage. Possibly, we may discover in this, one explanation of the Hare's spreading with the spread of cultivation. An advantage connected with this, possibly, is that the ploughing of the ground destroys the germs of many diseases that might otherwise make havoc in their numbers.

The home range of the individual Hare is probably not more than 2 miles across, maybe even smaller. It is well known that, when pursued, this animal rarely runs more than a mile from a central point, but circles around that; also that a Hare, once discovered, may usually be found thereafter within a few hundred yards of the same place.

In 1892, while I was living at Carberry, William H. White told me one evening, that an immense Rabbit or Hare was on his pea-field that day. It was some new kind, larger than any he had ever seen in the country before, and that if it was like its cousin, the English Hare, it would be found on the same spot, at the same time next day. This proved correct; I found the Hare in its form on the pea-field. It turned out to be the present species.

In the Park at Wyndygoul, where I had Whitetails for years, I found that each individual kept closely to his own region of 10 or 15 acres, though free of 120.

---

[4] Aug., 1920, p. 186.

Analogy also bears out the theory of a limited range. T. W. Proger, the Welsh naturalist, writes me concerning the European Hare, which is closely akin to our own: "The home locality of the Hare is less than 2 miles across"; that is, a radius of 1 mile; around this, it runs when pursued. I have proved a similar habit in the Jackrabbit of Kansas. So that a small range is the family rule.

NUMBERS AND MIGRATIONS

In the New York *Tribune* for Jan. 27, 1924, p. 7 of the magazine supplement, is the photograph of a pile of Jackrabbits taken in a 3-days' drive at New England, near Bismarck, N. D. The total bag was 7,250.

This Hare is not at all migratory. At most, it changes its range in winter to adjoining places that are warmer, or better supplied with food.

Crepuscular. Like most of its group, it shuns the noonday glare. Indeed, it is not at all a Sun-child, as are so many of the Order. Neither does it prefer the black night, but finds its choicest time to feed and roam, in the soft, half-light of the gloaming—sometimes an hour before sunrise, but more often in the evening as the shades begin to fall.

AS A FREEZER

In the Life of the Mule-deer (Vol. III, p. 361) I have emphasized the "freezing habit" of that animal—its power to turn into a motionless statue when that is obviously the safe play. All of the Rabbits are well gifted in this direction. Molly Cottontail is famous; and the present species is equally clever at the ruse.

The deception is more complete if the Hare refrains even from winking; and this it is said to do. There are questions that, in consequence, have been put:

Does the Hare sleep with its eyes open? Does the Hare wink?

Many times, I have watched a sitting Hare to see if it winked; but always failed till recently. At Settle Station, Yorkshire, England, a dozen English Hares were in a crate. I watched them at a distance of a couple of feet, to see if they winked. After two or three minutes without change, I took out my watch, and focussed on the biggest and liveliest of the lot. Four minutes more elapsed; that is, altogether possibly 7 minutes, during which time there was no wink. Then my subject gave two or three very elaborate, heavy, sweeping winks, after which he again dispensed with the operation for a long period.

Food

The food of the species is nearly everything that is green or grain. In the winter, it adds to the list the bark of many shrubs, and comes by night to the gardens and barnyards of the farmers for a delightful change in the form of oats, hay, turnips, cabbage, and indeed all the stock foods, for it has a "crop for all corn."

The British Hare is credited by Robert Drane, of Cardiff,[5] with habitually eating its own dung, thus securing all nutriment by a process of double digestion, a sort of reversible rumination or *post mortem* chewing of the cud. This frugal habit has not yet been observed in American Hares; frugality is not an American characteristic.

Unsociable and Uncommunicative

"Nor is the Prairie-hare in the least gregarious," says Coues.[6] "I have never seen nor heard of several together, and indeed it is rare to find even two together at any season whatever. It is one of the most solitary animals with which I have become acquainted. . . . I have never found any kind of locality even, which, presenting special attractions, might invite many Hares together."

Lewis and Clark recorded[7] over one hundred years ago that these Hares, "are generally found separate, and are never seen to associate in greater numbers than two or three."

In noting the Hare's methods of intercommunication, we must not forget its uniform, so distinctive with its blazonment of markings black and white—markings that plainly advertise to all the world the wearer's identity; notifying others of the species that this is one of their own kind, and therefore, it is needless to flee; or showing the carnivorous foe with equal certainty that this is a Jackrabbit of winged heels, and therefore it is useless to follow.

When captured, this Hare sometimes utters a loud, coarse squealing; it is not unlike the "*caw, caw, caw*" of a crow.

The Hare of Europe, a close kinsman, has a soft, plaintive call for the young; and the Blacktailed Jack, when fighting with its own kind, utters an angry "churr, churr." These sounds also are probably used by the White-tailed Jack.

---

[5] Trans. Card. Nat. Hist. Soc., Pt. II, 1894–95.

[6] Prairie Hare, pp. 80–81.

[7] Expedition Missouri, 1804–06, Hosmer Ed., 1917, II, p. 190.

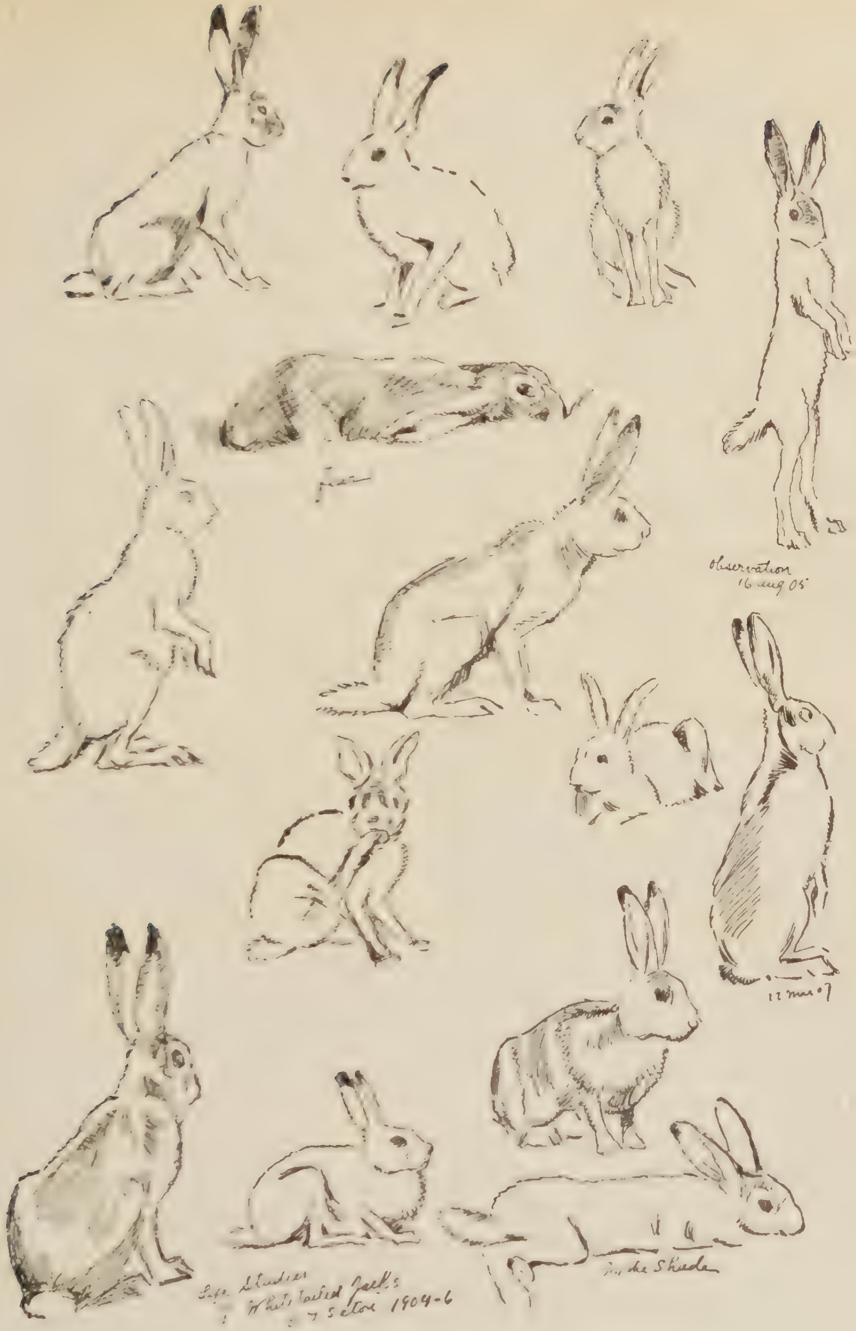


PLATE LXXXIII.—LIFE-STUDIES OF PRAIRIE-HARE

MATING STANDARDS LOOSE

Mating apparently takes place about the end of April. It is not known whether the species pairs or not; probably it is polygamous, and the male, therefore, is unlikely to take an interest in the young. A. S. Barton writes me from Boissevain, Man.: "The Jackrabbits run in packs after the females; about 20th of April, many people told me they had seen 4 or 5 together, and I once saw 3 all in a string."

As evidence in point, I quote from my own journal:

Cos Cob, Conn., April 28, 1906. For the past two weeks, I have noted in the park at Wyndygoul, 2 Jackrabbits—one a Whitetail, the other a Blacktail—running and keeping together, evidently paired. [They continued together for a year afterward.] I have also seen at another part of the park 2 Whitetails running together. These things incline to show that the species does pair. In the former case, it looks as though they were at times guilty of mesalliance. The weight of evidence at present, however, would prove the Prairie-hare addicted to polygamy, or even a still lower order of matrimony—catch-as-catch-can.

NESTING AND YOUNG

The Prairie-hare has many forms or beds where it sits in certain seasons; but it is not known to prepare a nest or cradle for its young.

Gestation lasts 30 days with the true Hares; and no doubt, the rule applies here, as this is a true Hare. The young are born in June or even early July, often the latter in Montana, according to Dr. Coues,[8] who studied them in the Milk River country. They are 3 to 6 in number, 4 being the most frequent.

The young of the European Hare are born with eyes open, and continue in hiding for about three weeks, during which time they are suckled two or three times a day. The father, it is generally believed, takes no interest in the young. After a month, the little ones begin to follow the old one, and learn what to eat and what to let alone.

These remarks are found to be near the truth for the Prairie-hare.

Some interesting notes on the development of the young have been supplied me by Percy H. Selwyn, of Ottawa, Ont. The first Jackrabbit he ever saw in Manitoba was at Elliot Settlement, 18 miles southeast of Brandon, on May 25, 1885. He fired at it, it fell dead; and he was sorry to see that it was a female evidently within a few hours of becoming a mother, for there was something moving in her body. On performing the Cæsarian operation, he found 3 young, one dead from the shot, the other two very active and with *eyes open*. When set on the ground, they ran about so quickly as to be hard to catch. He took them home and raised them by spoon-feeding. From the first, they were perfectly tame, and became the most playful Rabbits he ever saw, leaping high in the air, and turning so as to alight facing the other way. When 3½ months old, and about half-grown, they were killed by accident.

---

[8] Prairie Hare, p. 83.

Similarly, A. S. Barton, after much experience among the Hares in southern Manitoba, writes me: "The young ones make good pets, they are so easy to raise on milk, and soon learn to drink out of a saucer."

When 5 to 6 weeks old, the young are big enough to shift for themselves.

Many observers believe that, in Manitoba, this Hare has two litters a year. Dr. Coues thought one litter a year was all it reared in Montana.

In the Yakima Valley (Wash.), the farmer assured me that the Whitetails breed every month of the year except February. This I interpret to mean that young ones are continually seen, except in the depth of winter; which would show at best that two or perhaps three broods are reared each year in the warmer regions of the Whitetails' range. But in the latitude of Manitoba, I believe one brood each season to be the rule.

SPEED

The Whitetailed Jack is undoubtedly the speediest wild four-foot left on the northern prairies to-day. In my scale of swiftness, I have put it next to the Antelope. It is far faster than Dog, Coyote, or Fox, and can often outrun the greyhounds in an open chase. "Captain Lewis measured the leaps of this animal, and found them commonly from 18 to 21 feet;[9] and many observations lead to the conclusion that it can travel for a mile or more at the rate of nearly 30 miles an hour.

For example, on Oct. 24, 1924, I was travelling from Hartney to Ninette in southern Manitoba. A Jackrabbit ran alongside the train, exactly keeping pace with it for 100 yards. We were going at a known rate of 30 miles an hour.

This high velocity was doubtless a result of the severest pressure. I suppose we are safe in estimating that at least once a day a Jackrabbit must save itself by its speed, and at least once a week it is hard pressed in a long race for life.

An individual that I watched closely while it ran at its easy, unafraid gait, covered 52 yards in 13 hops over the snow—an average of 12 feet to the half-speed hop.

---

[9] Expedition, Hosmer ed., II, p. 190.

All the Jackrabbits have a habit of making an occasional bound straight up in the air, to take an observation in Springbok fashion. This custom, seen at its highest development in the Blacktailed Jack of Texas, is at a minimum in the present species—I suppose because all its bounds are of the nature of spy-hops.

Several times while watching the ill-matched pair mentioned in the section on "Mating" I have had good opportunities of comparing the gaits of the two species. The Whitetail runs like a Deer, with high, long bounds; the Blacktail, lower, with shorter, quicker bounds, and much more regularly punctuated with spy-hops. Their courses may be thus suggested by the lines in the accompanying diagram (Plate XCVIII, p. 750).

A Swimmer

The Prairie-hare does not love the water, yet takes to it fearlessly when it must; and proves a strong swimmer, for the good reason that it can progress by the same motions as those which enable it to move on land.

Throughout the Yakima Valley of Washington, I was told that the Whitetailed Jack never hesitated to plunge into any water that barred its path, if too broad to be overleaped. It always manages, however, to shorten the swim considerably by leaping as far as possible at the start.

An aquatic exploit by this Hare has been described to me by an eyewitness, Col. L. L. Hawkins, of Portland, Ore. In the late fall of 1880, he was at work with a gang on the Snake River, 60 miles above its junction with the Columbia. He and his men stopped at a long, narrow island. It was about 500 yards in length, and 150 yards across; the widest part was covered with scrub; the rest was a long, bare point. As they landed, they saw a big Whitetailed Jackrabbit jump into cover. The whole gang of men went after him. They were 15 in number; and forming a line across, soon drove him out into the open and narrow part. He raced to the far point, then back a couple of times. They came within 50 or 60 feet of him, and now were nearly shoulder to shoulder, as here the point was only 20 yards wide. Seeing no other escape, the Jack ran to the left of the island, raced straight across to gather speed, then on the right side at the exact water's edge, he leaped with all his power into the river—covering fully 20 feet in that jump—and struck out bravely for the shore, 100 yards away. He swam very high and fast, splashing with his front feet, and moving forward with jerks as though jumping from his hind feet; his ears were laid back, and although the river was deep, cold and swift, he crossed about as quickly as a Dog would have done, and lost very little through drifting. As soon as he got on shore, he shook the water from his coat; then, sitting up high, he took one

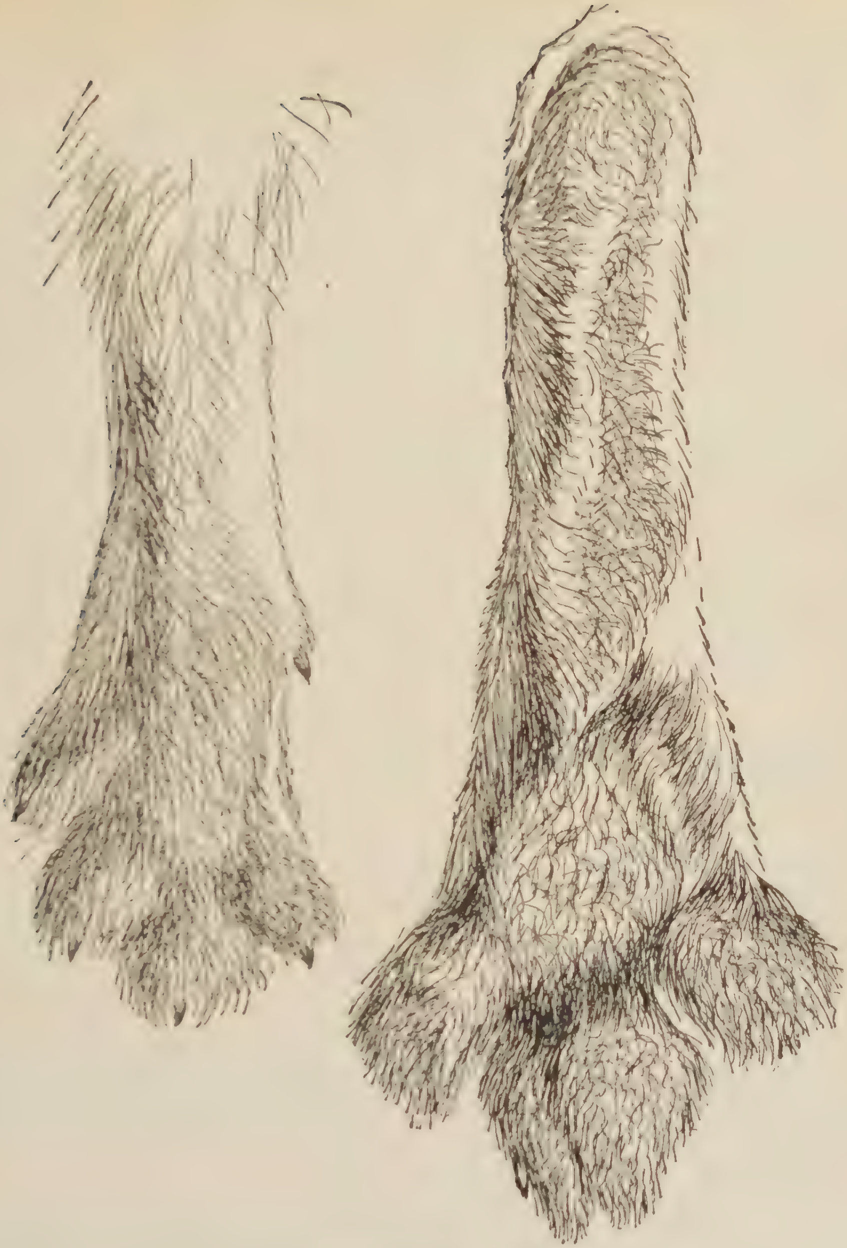


PLATE LXXXIV.—FEET OF PRAIRIE-HARE. LEFT FORE AND RIGHT HIND—LIFE SIZE. CHICAGO, MARCH 9, 1902 look at his foes, and bounded away into the sage. With one impulse, the men took off their hats, and gave him a cheer as he went.

When first they saw him on the island, Colonel Hawkins supposed the Jack had crossed over when the water was so low that there was a dry road; but, after seeing the way he swam, concluded that he crossed at any time he wished.

Dr. C. E. Johnson furnishes an even better instance: During the spring floods of 1900, he was at Warren, Minn: His Dog, a beast of Newfoundland blood, and the size of a setter, started a Jackrabbit which ran toward a flooded coulee; here the stream was about 50 feet wide, and going about 2 miles an hour.

"To my astonishment," says Johnson, "the racing Jack neither slackened its speed, nor swerved in the course to right or left. It had unlimited territory to either side, and had such a lead on the Dog that it could easily have chosen a different way. But it ran straight to the water's edge, plunged in without the slightest hesitation, and swam to the other side. Here it did not stop to shake the water from its fur, but bounded up the snow-covered banks, and sped on in the same general direction."[10] Ice-water! Ouch! Still he easily escaped.

His Foes and His Safety

The Hare is so swift that he needs but little art to escape his enemies. Cadham says that if pursued by one Dog, he commonly plays with it, teasing the Dog by allowing it to get very near. When two Dogs are turned loose, however, the Hare usually decides that present safety is better than posthumous glory; and proceeds to demonstrate that his are the winged heels and that nothing on four legs can catch him, when he wishes to leave the scene—as at present. When hard pressed, he is known to double back, make a tremendous side-jump, then squat.

An instance of this was told me by Chauncey Thomas, of Denver, Colo. He saw a wounded Jackrabbit walk along the railroad track for 200 yards, return, then jump and squat. The double he believed was intended to hide the track.

Hawks are among the Jack's most dangerous foes. Hamlin Garland tells me that, on the Colorado Plains, he once saw a Jackrabbit pursued by a hawk. The Jack made for a barbed-wire fence; and, dodging through, back and forth beneath it, easily escaped his enemy. The man-made importation gave the Jack an unusual protection.

---

[10] Journ. Mamm., Nov., 1925, pp. 247–48.

Another incident with a more heroic procedure is recorded as a "Jackrabbit's Savate"—savate being a French style of boxing in which kicking is the chief offensive. "A young professor in a South Dakota college witnessed a running fight between a hawk and a Jackrabbit last winter, and gives the readers of *The Companion* this interesting account of it:

"The Jack had ventured out from the natural protection of a cornfield upon a snow-covered prairie. He was discovered by a large hawk, which immediately sailed to the attack. As soon as the Rabbit saw his enemy approaching, he turned and made for the shelter of the cornfield. The hawk circled over him, and then made a swoop from the side across the Rabbit's path. For an instant, it seemed that the prize was his; but the Rabbit, with his ears lying back, continued to speed for the shelter ahead, until the hawk was nearly upon him. Then he suddenly stopped in his tracks; and as the hawk swept by just in front of him, he leaped high in the air, straight over the hawk; and, striking out with his powerful hind legs, sent his enemy tumbling in the snow.

"The Rabbit did it all with only a momentary pause that hardly checked the momentum of his rush for the cornfield. Four times the hawk rose in circles, and returned to the attack, to be met by the same novel method of defense. Each time the Rabbit stopped at the critical moment, and, leaping over his pursuer, struck with his strong legs. With a final burst of speed, he gained the cornfield, where the mat of stalks protected him from any further air raids."[11]

On the Central Plains, the golden eagle or war-eagle is to be reckoned with. Col. Theodore Roosevelt has described the tragic meeting of eagle and Jack as follows:

"On one occasion, while riding over the range, I witnessed an attack on a Jackrabbit. The eagle was soaring overhead and espied the Jack while the latter was crouched motionless. Instantly, the great bird rushed down through the humming air, with closed wings; checked itself when some 40 yards above the Jack, hovered for a moment, and again fell like a bolt. Away went Longears, running as only a frightened Jack can; and after him the eagle, not with the arrowy rush of its descent from high air, but with eager, hurried flapping. In a short time, it had nearly overtaken the fugitive, when the latter dodged sharply to one side, and the eagle overshot it precisely as a greyhound would have done, stopping itself by a powerful, setting motion of the great pinions. Twice this manœuvre was repeated; then the eagle made a quick rush, caught and overthrew the quarry before

[11] The Youth's Companion, Sept. 21, 1916, p. 528.

it could turn, and in another moment was sitting triumphant on the quivering body, the crooked talons driven deep into the soft, furry sides."[12]

The Fox is another enemy to be dreaded, chiefly, however, by the young; it is unlikely that it often secures a full-grown Jack. Dr. S. J. Thompson has given an incident that shows how this foe may be discomfited. While driving near Neepawa, Man., one day, Dr. Thompson saw a Jackrabbit that bounded along a prairie ridge, then suddenly squatted under a tussock. A Fox appeared close at hand; it also had seen the Rabbit, and slunk out of sight into a hollow, along which it ran as fast as it could, so as to come under the place where the Jack was sitting. As soon as it was within 50 yards, Reynard commenced an elaborate stalk, like a Cat, crawling on its belly till it was within 15 feet of the unwitting Rabbit. It was now as close as it could get undiscovered; so carefully placing each foot, it braced itself and made a grand leap, but fell short. The Jack was so alarmed that at first, he seemed to lose his head; jumped about back and forth and high in the air for a few times; but before the Fox could close, he got under way, and off they went. Within 100 yards, the Fox was left far behind and gave up the chase.

The Coyote was at one time a chief among the depredators of the Jackrabbit swarms—so much so, that the reduction of the Coyotes has resulted in a vast multiplication of the Jacks. In cultivated regions, the Jacks have been a menace to the crops, and the consequence is a reaction in favour of the Coyote as an essential counterpoise in nature's scheme.

DISEASES

A deadly epidemic of some sort has appeared more than once among the Prairie-hares in the far West, when they have been unduly multiplied; but I have not heard of this occurring among those in Manitoba. The whole Family, however, is notoriously beset by disease. A. S. Barton writes: "We have not eaten any of them for years; so many have on the back a cyst full of watery fluid and quantities of white eggs, which I take to be the eggs of tape-worm. This disease, or whatever it is, does not affect the condition of the animal in the least."

On Feb. 25, 1907, I opened a 2-inch cyst on the side of a large male White-jack in Wyndygoul Park; on March 14, I opened a much larger one on the same animal. It contained about 2,000 embryonic tape-worms, the size of No. 6 shot. The cyst was 5½ inches by 3½ by 2 inches high. The Jack seemed indifferent alike to cyst, worms, and operation.

---

[12] Wilderness Hunter, 1893, pp. 71–72.

Dr. T. S. Palmer, in his report on the Jackrabbits,[13] says: "Many persons have a prejudice against eating Jackrabbits because the animals are infested, at certain seasons, with parasites. . . . This prejudice, however, is entirely unfounded. The parasites of the Rabbit are not injurious to man; furthermore, the ticks and warbles occur at a season when the Rabbit should not be killed for game; while the tape-worm can only develop in certain of the lower animals, e.g., in the Dog or the Coyote. The most important parasites of the Jackrabbits are ticks (*Ixodes*), the larvæ of a fly (*Cuterebra*), and of a tape-worm (*Tænia*). Ticks are especially troublesome during the summer, and may sometimes be found clustered about the ears in great numbers. A large fly of the genus *Cuterebra* attacks these Hares as it does the Deer, Squirrels, and Wood-rats; and punctures the skin in order to find a suitable place to lay its eggs.

"The egg hatches soon after being deposited, and the parasite larvæ, becoming incased in a capsule immediately beneath the skin of its host, forms a lump sometimes an inch or more in length, which is usually known as a 'warble.' These warbles are most often seen in July or August. The larva emerges from its case in due time as a perfect insect; and the wound heals, leaving little or no scar.

"On some of the Rabbits brought to market, large 'water blisters' or 'boils' are occasionally found, which are the larvæ of a tape-worm (*Tænia serialis*). This larva is called *Cænurus serialis*, and has been found in the California Jackrabbit (*Lepus californicus*), the Prairie-hare (*L. campestris*), the Old World Hare (*L. timidus*), and Rabbit (*L. cuniculus*), the Coypu of South America (*Myopotamus coypu*), a species of Squirrel (*Sciurus*), and in the Horse. *Cænurus* does not develop into the adult tape-worm in any of these animals; but in the Dog and the Coyote, which eat many Rabbits, it reaches the adult stage."[14]

The Whitetails in my grounds have died from enteritis, pneumonia, and what I took to be hæmorrhagic septicæmia.

HIS TALE OF YEARS

Having met and overcome this list of ills, what may be the tale of his years at their fullest expectation? What age does the hearty White-jack reach? Analogy is our only source of light here. Cowper's tame Hares of the British species lived, respectively, the male 8½ years, the female 10 years. Miller Christy tells me that he knew of an English Hare that lived 12 years in captivity.

---

[13] U. S. Dept. Agri. Bull. 8, 1896, pp. 71–72.

[14] This list of hosts of *Tænia serialis* was furnished by Dr. C. W. Stiles, U. S. Dept. Agri.

Jack in the Landscape

Who can adequately describe the wonderful thrill of delight—half animal, half poetic—that comes when first he sees a wild Deer bound away from his path? The old, old thrill it is, that dates from times when finding that Deer was a matter of life or death. This same vivific shock I never cease to get each time I see a Whitetailed Jackrabbit leap up from his near-by lurking place. It never fails to be two things—unexpected and superb. You never know where you may find a Jack—no one does—you never see him till he leaps at close range, and lopes away in stiff four-cornered bounds, rising without effort, like an Antelope, and switching his great white brush from side to side, like a miniature Whitetailed Deer: blazing with snowy white, and punctuated with sharp black spots on his ears. He is the king of all his kind, the largest and finest of the Hares that roam the great, high plains. The Blacktailed Jacks of New Mexico and California I got used to, without, however, entirely losing the little sudden taste of a naturalist's joy, as the live, lithe things sprung from my path; but the great Whitetail of the North, with its sudden leap into life and showy contrast on the plain, where a moment before it was a dead, invisible clod, never fails to give the hunter-thrill that can scarcely be felt when we slowly creep up on a larger creature that we have watched and stalked for hours.

A bright pen picture of this Hare in its home has been given by Dr. E. Coues:[15] "The first sign," he says, "one has usually of a Hare which has squatted low in hopes of concealment, till its fears force it to fly, is a great bound into the air, with lengthened body and erect ears. The instant it touches the ground, it is up again, with a peculiar springy jerk, more like rebounding of an elastic ball than the result of muscular exertion. It does not come fairly down and gather itself for the next spring, but seems to hold its legs stiffly extended, to touch only its toes, and rebound by the force of its impact. The action is strikingly suggestive of the 'bucking' of a Mule—an affair with which people in the West are only too familiar. With a succession of these high, jerky leaps, the animal makes off, generally in a straight course; there is nothing of the dodging or scuttling about that marks the running of the smaller Rabbits. As it gains on its pursuers, and its fears subside, the springs grow weaker, just as a flat stone 'skipped' on the water diminishes in length of the rebounds; and finally the animal squats in its tracks on its haunches with a jerk, to look and listen. . . .

"The attitude at such times is highly characteristic. One fore foot is advanced a little before the other, and the ears are held pointing in opposite

---

[16] Prairie Hare, pp. 84–85.

directions. A Hare in such an attitude as this is always upon the watch, and the slightest stimulation of its fears at such a time, is enough to start it on its bounding course. It is a beautiful exhibition of timid watchfulness."

WORTH TO US

When in point, I have included in each of these Lives a consideration of the creature's value, or service to man. In the present case, this is not evident in material form. The Prairie-hare's pelt is so fragile, in fur and in hide, that it does not constitute an acceptable barter stock, even where the fur-trade rivalry is keenest. The flesh is wholesome food, but has never achieved any popularity. The Hare may yet establish itself as "desirable game," to which rank all sporting men should aim to help it as a measure of protection. But so far, it has hardly left the "vermin list," much less appeared on the "high game" where it should be.

In making apologetic enumeration of possible virtues, I feel myself guilty of something like special pleading, of making an appeal to the earthy jury, called "lawmakers"; for, after all, the creature's claim strongest with the lovers of the wild things, certainly with myself, is this—that, like so many I would save, without being able to prove their economic worth, the Hare is an exquisitely beautiful creature, an ornament to the plains, a delight to behold. I would preserve it, and a hundred others—even as I would preserve a beautiful picture or view—for the unsordid joy of feasting the eyes on a sentient fellow-creature, that is a little pinnacle on the cathedral of evolution, and glorious as an exemplar of beauty in the wild way of life.

REFERENCES

1799–1814—Journal, by Alexander Henry, see Beaver References, p. 500.

1876— Synonymy, Description, History, Distribution and Habits of the Prairie Hare (*Lepus campestris*), by Dr. Elliott Coues, Bull. Essex Institute, VII (1875), pp. 73–85.

EUROPEAN HARE, in New England called JACKRABBIT

Lepus europæus Pallas

This large, handsome Hare has been introduced into America within the last 30 years, and is now established and abundant in several regions. It is found in the Hudson River Valley as far north as Albany, and eastward for 50 miles into the adjoining parts of Connecticut, Massachusetts, and Vermont. In New Jersey, it has appeared in the central and northern parts; and it has spread into the contiguous parts of Pennsylvania.

In Ontario, it is scattered over the counties immediately north of Lake Erie—that is, the whole peninsula west of Toronto and south of Alma.

Full information on the introduction and spread of the species is given by James Silver, of the Biological Survey, U. S. Dept. Agriculture.[16]

The European Hare is unlike any other in the region above named. First, it is much larger, being 9 or 10 pounds in weight. It is of deeper, richer colours than any of the large Hares in the West.

The only species in the East with which it needs comparison are the Cottontail, and the Snowshoe in summer pelage.

First, the Hare is by far the largest of the three—about double the weight of either of the others.

As to the colour: Above, the Hare is of a soft wood-brown or dull buff, thickly flecked with darker colour, due to the blackish lower part of the hairs showing through; the tips of the hairs are pale. The Cottontail is much redder in general—though gray on the rump—everywhere lined over with the black tips of the hairs overlying the rest. The Snowshoe is of a warm gray brown, much deeper and much yellower than the Hare, and peppered, as in the Cottontail, with black hair-tips.

The Hare's bib and flanks are reddish like the Cottontail's nape; the Cottontail's bib and flanks are soft buffy, like the Hare's back; the Snowshoe's bib and flanks are gray-brown like his own back. The Hare's nape is faintly reddish; that of the Cottontail, strongly reddish; that of the Snowshoe, without a trace of red.

All three are white below, but the Hare's chin and throat are reddish yellow; those of the Cottontail and the Snowshoe are white.

The underwool on the Hare's back is white; that in the Cottontail and the Snowhoe is dark leaden gray. The Hare and the Snowshoe always have a black tip on the ear behind; the Cottontail never has. The Hare's tail is black above, and snow white below; the Cottontail's is gray above, and snow white below; the Snowshoe's is very short, dark gray above, and dull whitish below.

According to James Silver, there are at least 50,000 of the European Hares now in this country, and the species is steadily increasing. Its life history is much like that of our Prairie Hare, and is fully set forth in J. G. Millais' "Mammals of Great Britain and Ireland," 1906, III, pp. 3–39.

---

[16] Journal of Agricultural Research, Vol. XXVIII, No. 11, June 14, 1924, pp. 1133–37.

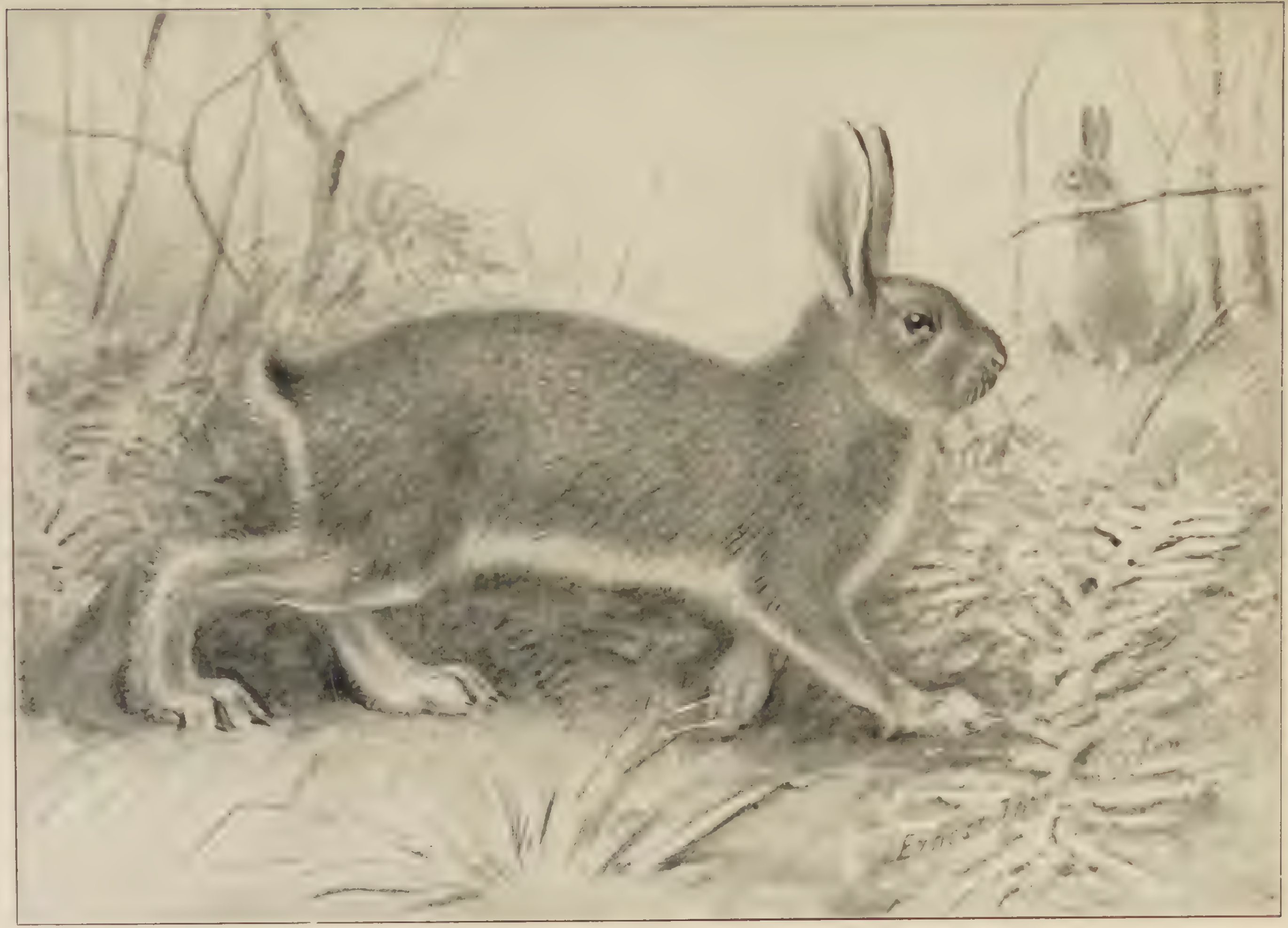


PLATE LXXXIX.—SNOWSHOE-RABBIT IN SUMMER COAT

(*Lepus americanus* Erxl.)
From specimen taken at Carberry, Manitoba, in June, 1883

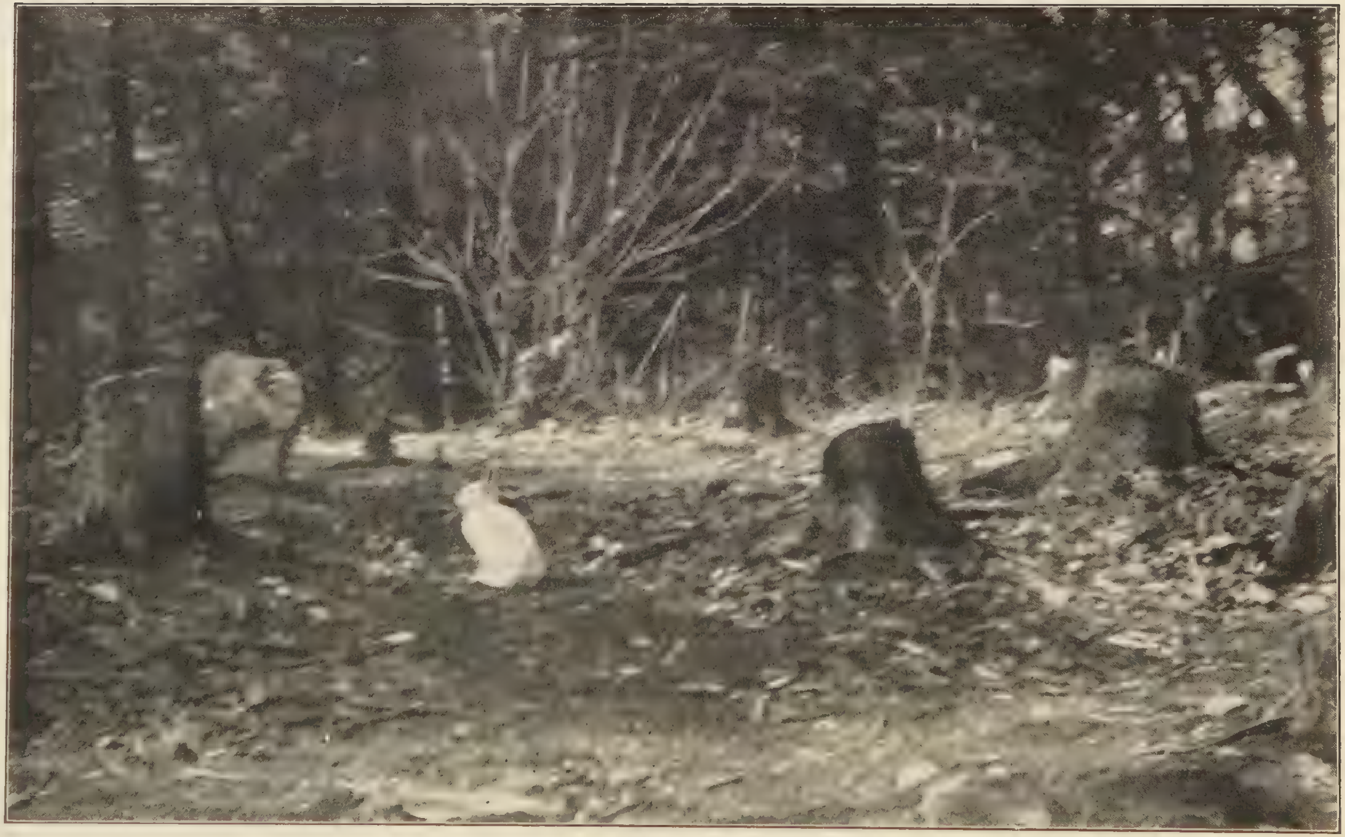


PLATE XC.—PHOTOGRAPH OF SNOWSHOE-RABBIT (FROM NEW HAMPSHIRE)

To show complete assumption of white coat before there was any snow

LIFE XCIII—ARCTIC HARE

PAGE
Names 668
Description: Size, Weight, Colour 668
Anatomy 669
Changing His Coat 669
Races 670
Range and Haunts 670
Numbers 671
Food 673
Enemies 673
Powers and Gifts 674
Form 675
Solitary 675
Mating and Young 675
Tamable 677
Hunting 678
His Way of Life 678

References 679

Arctic Hare, or Alpine Hare of Hudson's Bay

Lepus arcticus Ross

(L. *Lepus*, a Hare; L. *arcticus*, of the Arctic region)

Lepus arcticus Ross, 1819, Voy. Disc., 8vo. ed. II, App. IV, p. 151.

Type Locality—Lat. 73° 37′, in North Baffin Land, southeast of Cape Bowen

Eskimo, *Oo-ka-lik* (Richardson).
French. *Lièvre arctique d'Amérique.*
Chipewyan, *Ka-choh.*

As this is a creature of the Arctic fauna, but not in the region nearest the Pole, it is well to restrict the name "Arctic" to this, and "Polar" to the *groenlandicus*, which dwells nearer to the Pole.

Size. Total length, 24 in. (609 mm.); tail, 2½ in. (63 mm.); hind foot, 6½ in. (165 mm.); ear from notch in dried skin, 3¼ in. (82 mm.); ear from base behind on fresh specimen, 6 in. (152 mm.).

Weight. 8 lbs.[1] A female which I took at Aylmer Lake, Aug. 14, 1907, weighed 9¾ lbs.; a ⅔-grown female taken at the same place, Aug. 19, weighed 5 lbs. Richardson gives it at 7 to 14 lbs.[2] Hearne says that "they are, when full grown and in good condition, very large, many of them weighing 14 or 15 lbs."[3]

Colour. Summer coat: General colour of upper parts and chest, soft plumbaceous gray, thickly peppered; nose, brownish, shaded into the pale gray of the face; ear-tips, jet black; eye-rings, whitish; chin, pale leaden gray; tail, belly, and feet, pure white, except that the soles are stained deep brown. The nursery fringe is pure white, with a leaden tinge or stain on each knee.

In the northern part of Baffin Land, the summer coat continues entirely dull whitish, except the black tips to the ears.

In winter, everywhere pure white, except small black tips to ears; and, of course, the eyes, which are yellow.

---

[1] Fisher, Voy. Disc., p. 119.

[2] F. B. A., I, p. 222.

[3] Journey, p. 383.

ANATOMY

Samuel Hearne, in the story of his famous journey to the Coppermine in 1774, tells of a curious thing about the Hare in these regions. After mentioning, to discredit, a popular notion that the Reddeer of England yearly sheds the glans of the penis, he says: "With equal truth, I can assert, and that from ocular demonstration, that the animal which is called the Alpine Hare in Hudson's Bay, actually undergoes something similar to that which is vulgarly ascribed to the English Deer. I have seen and handled several of them, who had been killed just after they had coupled in the Spring, with the *penis* hanging out, dried up, and shrivelled, like the navel-string of young animals; and on examinations, I always found a passage through them for the urine to pass."[4]

What the meaning of this is, I cannot say; but coming from Hearne, it is sure to have some foundation, and to be worthy of investigation.

CHANGING HIS COAT

In the northerly half of its range, this Hare continues white, or nearly white, all summer, for obvious reasons—the season is too short for a complete change, and the presence of snow and white ice all summer renders the change unnecessary.

In the southerly half of its range, the species begins to shed its white coat in April, early or late, according to latitude. For a time, it is in white and brown; so is the world about it. In May sometime, the change to brown is complete in those regions where it is made at all.

In October, those that were brown, resume the white coat. This includes the young which are, in all species, gray-brown; suggesting, if not proving, that the ancestral stock was brown, and the white coat a recent adaptation.

So white is this winter coat, that the creature might defy detection as it sits on the snow, but for the black ear-tips and bright amber eyes; and these, of course, do not betray it to an enemy far off. They may, however, be considered directive marks for its friends.

A young one in the gray-brown coat was captured, apparently on Boothia Peninsula, by Capt. J. C. Ross, and brought up as a pet. Concerning its change of colour, he says:

"Although constantly in a temperature never much below the freezing point, its fur assumed its white colour as early as those that were running wild, and exposed to the climate; and although it cast its winter coat early in May, it was replaced by a pure white fur."[5]

---

[4] Journey, p. 200.

RACES

The following races have been recognized:

arcticus Ross, the typical form. T. l., Baffin Land, S. E. of Cape Bowen.

bangsii Rhoads, much like southern *arcticus* in summer, but head duller buffy, grizzled with gray; body in full summer pelage, grizzled smoky gray; ears, nearly all glossy black. T. l., Codroy, Newfoundland.

canus Preble, much like southern *arcticus*, but paler gray on head and body. T. l., Hubbard Point, Hudson Bay, Canada.

othus Merriam, largest of the group; colour in summer, much the darkest and brownest. T. l., St. Michael, Norton Sound, Alaska.

poadromus Merriam, in summer, cinnamon brown above, tinged reddish on head; front feet brown, hind white. T. l., Stepovak Bay, Alaska Pen.

labradorius Miller, like *arcticus*, with widespread rami of lower jaw, and very large nasal bones. T. l., Ft. Chimo, Ungava.

RANGE AND HAUNTS

The range, as set forth on Map XVIII (p. 684), may be otherwise expressed as—the Arctic Fauna, south of latitude 74°. In this great treeless belt, it is found wherever there are dry open plains, variegated with rocky hills.

The favourite haunts of this Hare are the open plains without trees. Though venturing to the very edge of the "Land of the Little Sticks," it never enters the woods. Summer or winter, it keeps to the open, preferring always the low hills that are rocky or strewn with boulders. In low thickets, such as are frequented by the Snowshoe Rabbit, or level, open plains that are so acceptable to the Jackrabbit, we look in vain for the Arctic Hare. Rocks are its specialty in the way of cover, and the rockier the hills, the better it likes them.

"There is scarcely a spot in the Arctic regions," says Ross, "the most desolate and steril that can be conceived, where this animal is not to be found, and that too throughout the winter: nor does it seek to shelter itself from the inclemency of the weather by burrowing in the snow, but is found generally sitting solitary under the lea of a large stone, where the snow drift, as it passes along, seems, in some measure, to afford protection from the bitterness of the blast that impels it, by collecting around and half burying the animal beneath it."[6]

---

[5] Nat. Hist., 2d Voy., p. xvi.

In Newfoundland, according to Henry Reeks, it "appears tolerably plentiful throughout the island. [There] it is a thoroughly alpine species, never descending to the plains except when driven to do so in search of food during two or three months in the depth of winter."[7]

NUMBERS

In the country north of Lake Aylmer, where I met the species in 1907, it was rare, so that in two months, I saw only 3. In the Barrengrounds along the Arctic coast of Canada, Roderick MacFarlane found it so scarce that he secured only 3 specimens during his five years' residence at Fort Anderson.[8]

"These animals are really not so very rare on the Barren Ground," says Stefansson, "as one may see by their traces left on the snow in winter; but in my entire Arctic experience, I have seen only 4 or 5, and have never shot a single one."[9]

So that it is not generally abundant. The only places where it is definitely known to occur in great numbers is in Alaska. On Alaska Peninsula, L. L. Bales found these Hares numerous.[10]

In the flat country around the mouth of the Yukon, Nelson says, "it is numerous in all the open coast country from the mouth of the Kuskoquim River to the Kotzebue Sound district. From this latter point north along the Arctic coast, these Hares are more and more scarce, until in the vicinity of Point Barrow, where they are unknown, according to Mr. Murdoch.

"In the interior, however, wherever open barrens are found along the Kuskoquim and Yukon rivers and to the northward, the Polar Hare is more or less common. On the Bering Sea Islands, they are unknown except on the island immediately adjoining the mainland, such as St. Michaels and Nelson's. The open country of the Yukon delta is their place of greatest abundance, as far as I was able to learn. There, in May, 1879, I found them very common. The snow was nearly gone; and, while travelling along the

---

[6] Nat. Hist., 2d Voy., pp. xv, xvi.

[7] Notes on the Zoology of Newfoundland, Zoologist, March, 1870, p. 2045.

[8] Through the Mackenzie Basin, 1908, p. 247.

[9] My Life with the Eskimo, 1922, p. 211.

[10] Outdoor Life, July, 1913, p. 22.

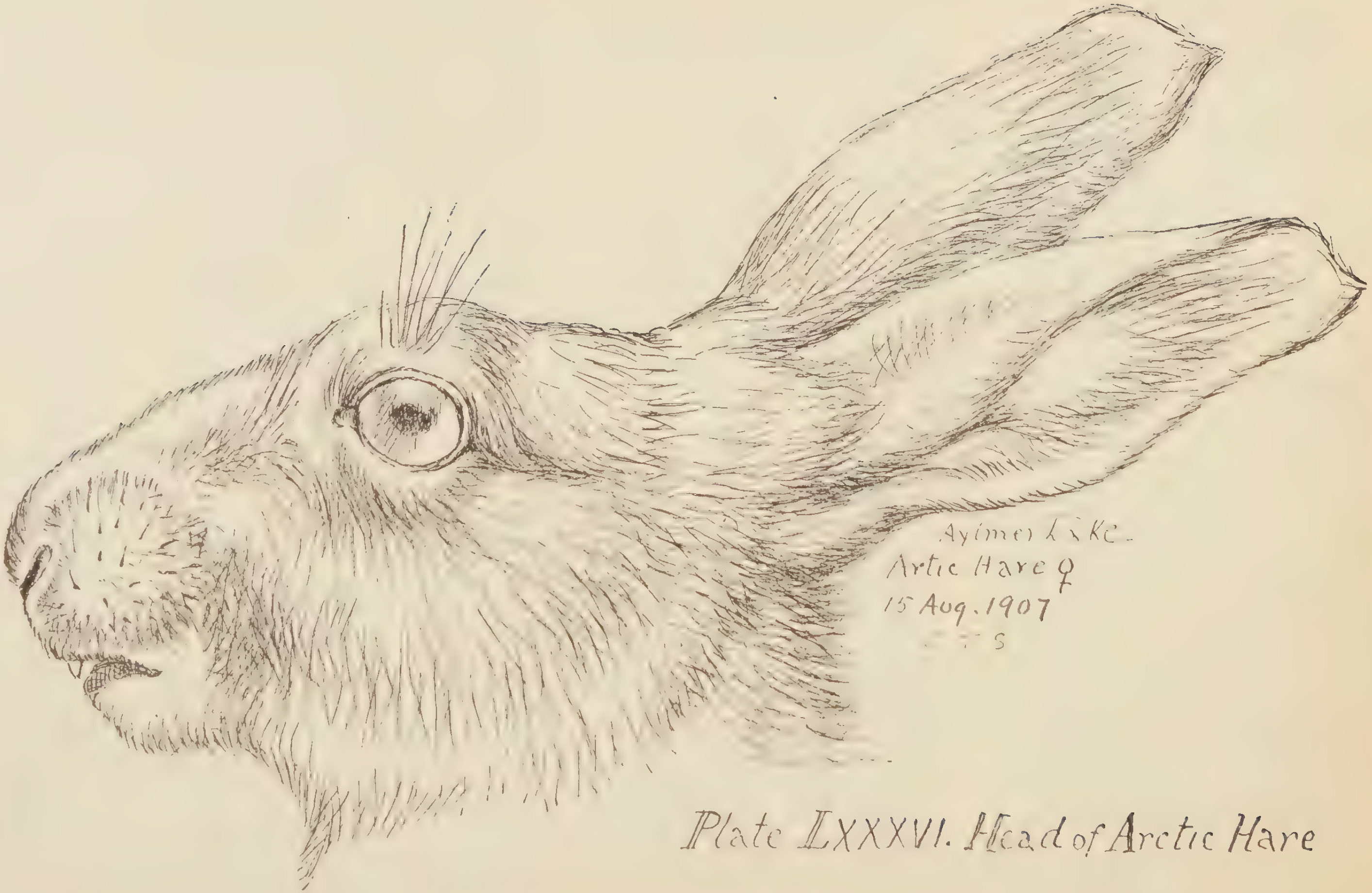


Plate LXXXVI. Head of Arctic Hare

small channels between the islands in the pale twilight which marks the nights at that season, we saw many Hares playing about on the banks. They were often in small parties of from 3 to 5 or 6, and were not very shy."[11]

"This species [*othus*] is fairly numerous on the tundra back of Kotzebue. After crossing the ice of Goodhope Bay, Bailey saw the tracks quite commonly on the south shore of Kotzebue Sound."[12]

FOOD

The collected remarks of Northern travellers go to show that the Arctic Hare eats the same sort of food as Hares elsewhere; that is, every kind of grass, shrubs, and flowering plant that is found in its haunts; and is especially fond of the catkins, leaves, bark, twigs, and roots of the dwarf willow.

According to Hearne, "In Winter, they feed on long rye-grass and the tops of dwarf willows; but in Summer, eat berries, and different sorts of small herbage."[13]

Lyons writes on Winter Island: "On the 8th [Jan. 1822] a Hare was killed while seeking food on our dirt heap. It was very thin, and weighed 7 lbs. On dissecting, it was discovered that the leaves of the herb-tea which was served out to our people, had been the cause of its frequent visits alongside."[14]

Richardson says: "It seeks the sides of hills, where the wind prevents the snow from lodging deeply, and where, even in the winter, it can procure the berries of the alpine *arbutus*, the bark of some dwarf willow, or the evergreen leaves of the Labrador tea-plant *(ledum)*."[15]

ENEMIES

Every predaceous bird and beast in the Far North preys on the Arctic Hare whenever it can catch it. Bears, Wolves, Wolverines, Foxes, gyrfalcons, and snowy owls are the natural enemies it is forced to guard against when fully grown; and as a fluffy, helpless leveret, it is the easy prey of skuas and ravens, as well as of Weasels.

The Muskox and the Caribou are the only big land animals that it need not fear. And it seems fully aware of the fact; for Hares will play in and around the herds of these ruminants, possibly realizing that, in the Muskox at least, it may find a guardian from Wolves.

---

[11] Alaska, p. 271.

[12] Bailey & Hendee, Journ. Mamm., Feb., 1926, p. 21.

[13] Journey, p. 383.

[14] Private Journal, p. 76.

[15] F. B. A., I, p. 221.

The universality of its enemies has made the Hares amazingly shy. In lands where gunners abound, we expect the game to be the most ready to flee. But the Arctic Hare, living alone, and maybe never seeing a man more than once in a lifetime, is more ready to run than any of its relatives that I have seen. Those that I met around Aylmer Lake, left their forms, and fled away long before I was within gunshot.

Against owls and falcons, the Hare's speed could avail but little. The only safety from them is a thicket of Arctic willow, a cleft rock, or a hole in the snow. It is well to remember that, in the North these birds of prey are found only during summer. If any of them are raiding in Hare-land during April and May, or September and October, the Hare eludes them by hiding all day, moving about only at night. Nelson says that in May at the mouth of the Yukon, he "found them to be almost entirely nocturnal in their habits, rarely moving about in daytime, even during the gloomy days when the sky was obscured by dense, low-lying clouds. Although they are nocturnal in their habits, yet they see very well in the days and it is extremely difficult to surprise one in its form. Usually, it spies the hunter before he gets within gunshot, and leaves the spot in great haste."[16]

In view of these statements, we are confronted by a puzzle—there is *no night* in the true Arctic regions during summer.

POWERS AND GIFTS

Against the Wolf and Fox, his speed is his protection; but be it noted that neither Wolf nor Fox is a very fast runner; it is morally certain that neither of these could run with the Coyote. This, with all other evidence at hand, goes to show that the Arctic Hare is not nearly so speedy as his cousins, the Jackrabbits of the South.

Those who have noted the Northern Indians' horror of the water, and realized that no Eskimo can swim, must be a little surprised to learn that the Arctic Hare swims readily and well. Nelson says that in Alaska during May, "the beds of creeks and other hollows are filled with slush and water, covering the ice below. This water is frequently several feet deep; and in many instances, I saw places where these Hares had come down to the bank, and, judging from their tracks, had plunged in without hesitation, and swum across to the opposite side. Their tracks showed, by the shortness of the jumps as they approached the water, that they were in no way fright-

---

[16] Alaska, pp. 271–72.

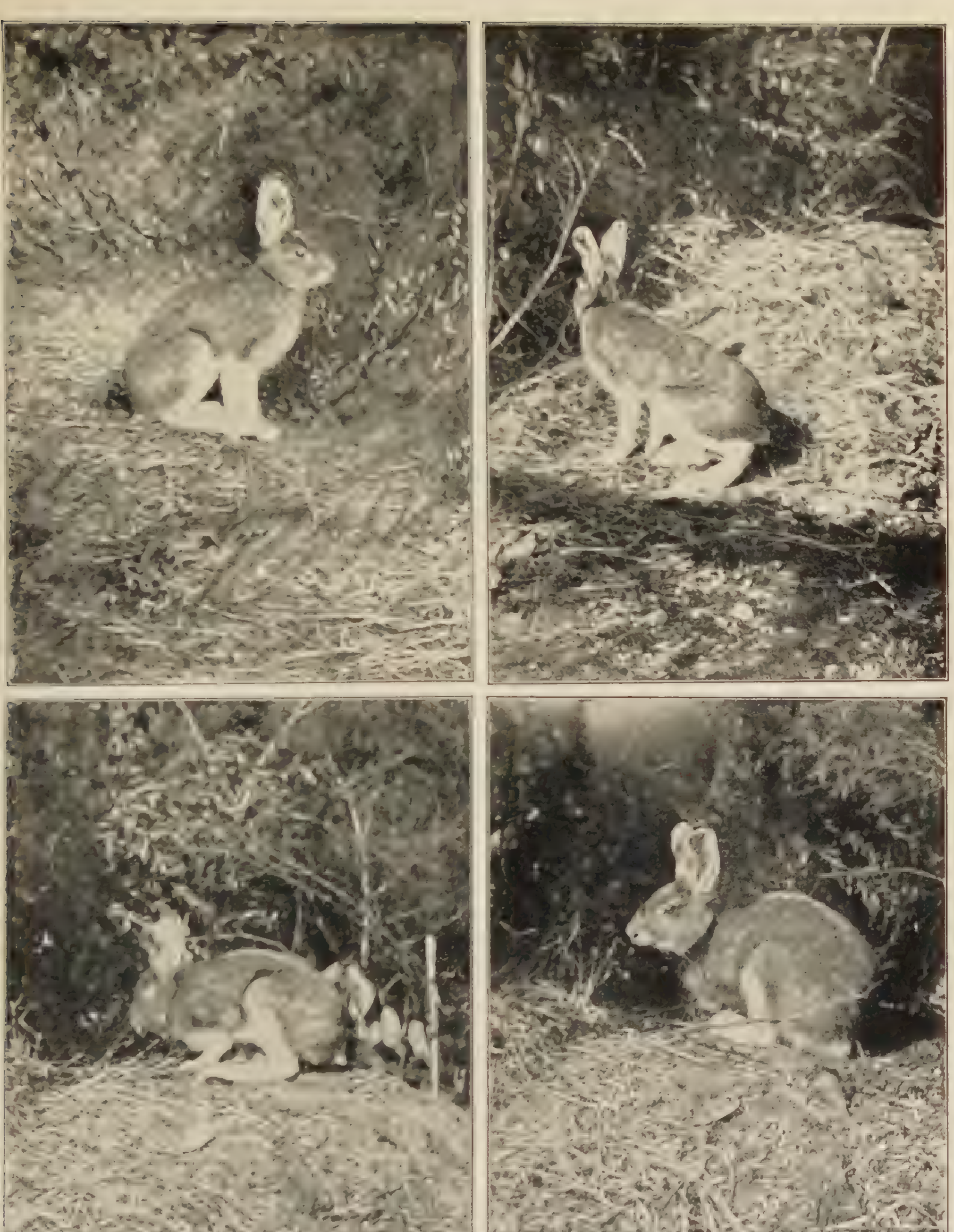
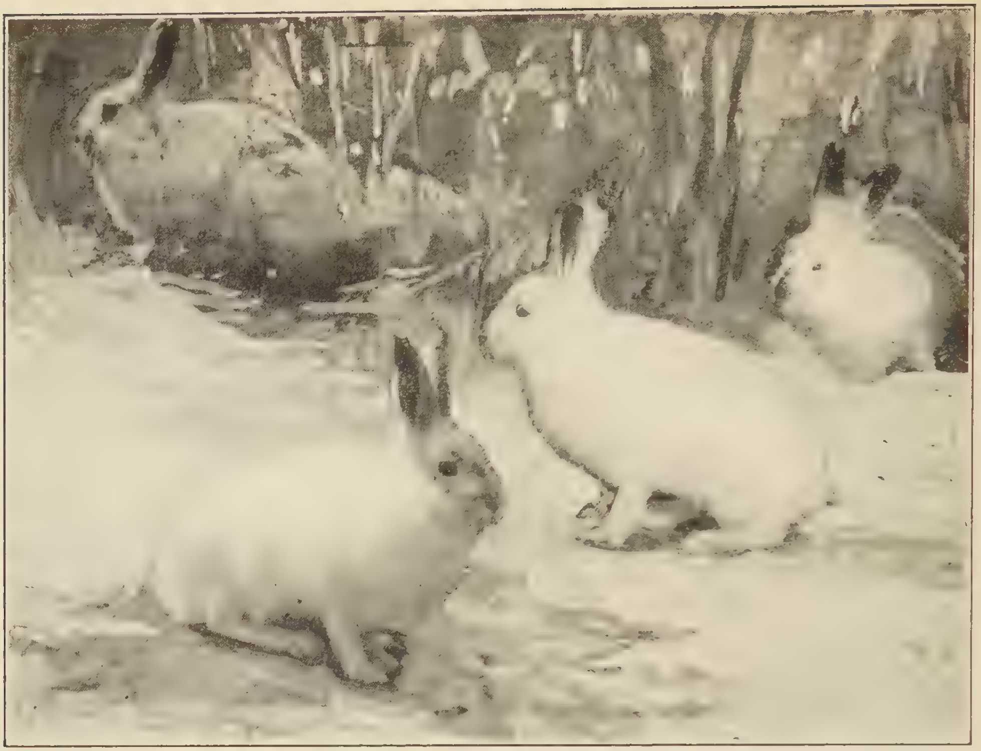
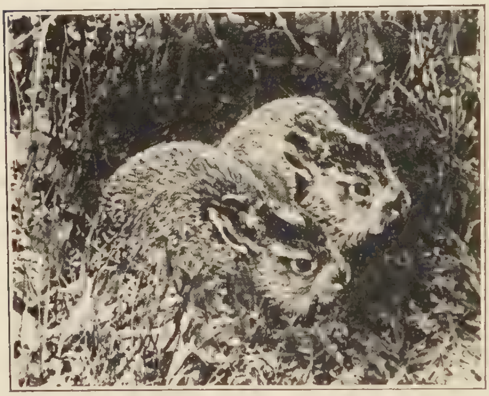
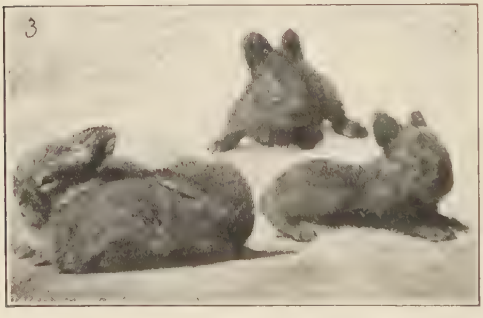


PLATE XCII.—SNOWSHOE-RABBITS PHOTOGRAPHS

To show the autumnal change of colour beginning on the feet, legs, and ears







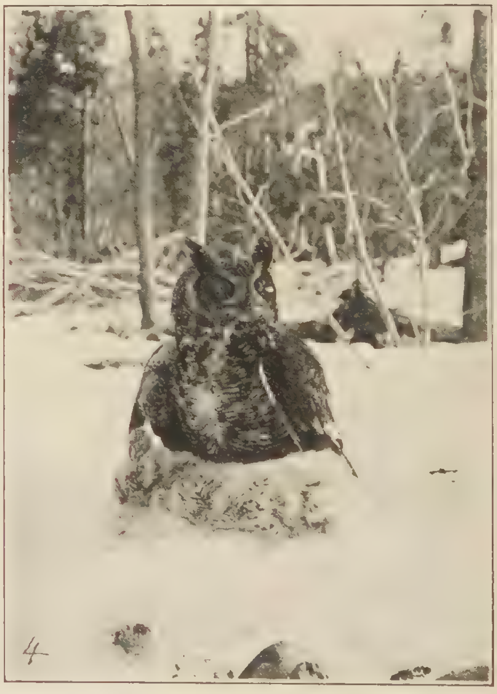


PLATE XCIV. SNOWSHOE-RABBITS, YOUNG, AND ENEMY

No. 1. Snowshoe Rabbits, winter, photo. by E. T. Seton
No. 2. Young Snowshoes, by H. & E. Pittman, of Wauchope, Sask.
No. 3. Baby Snowshoes, by Mrs. M. Bedard Caldwell

ened or forced to cross. In one case, a stream over 30 yards across, was thus passed by one of these animals."[17]

FORM

The form, or, as our own Western folk would call it, the bed, is any smooth hollow of natural make, sheltered by some rock or overhanging stone. It has no lining, and even in the dead of the deadliest winter storm, the Hare considers it comfortable if it shelter him from the direct force of the wind.

There is every reason to believe that, in extreme weather, the Hare allows the snow to bury him as it falls, or will even burrow a little way into it as do some others of the Hares. But so far, no one has recorded it.

SOLITARY

In the life of the Whitetailed Jackrabbit, it is shown that, though so abundant in places, the Jack is far from being gregarious. The same remarks apply to this Hare. Nelson says:

"During most of the year, these animals are essentially solitary; but during April and May, they gather into small parties, and sometimes as many as a dozen or more may be found on a single hillside."[18]

MATING AND YOUNG

The small parties mentioned by Nelson are, of course, the result of the sex-urge; and the inference is that the mating takes place about the first of May. The young, then, should arrive about the first of June; and what little evidence is at hand, shows that in all its doings at this time, the Polar Hare resembles closely its blood-kinsmen, the Common Hare of Europe, and our own Jackrabbits.

The young number commonly 2 to 4, but may be as many as 8. Richardson mentions the interesting fact that "a nearly mature foetal specimen was of a blackish brown colour on all the upper parts and outsides of the extremities."[19]

Similar testimony comes from J. C. Ross. He says: "A female killed by one of our party at Sheriff Harbour [Boothia Peninsula], on the 7th of June, had 4 young *in utero*, perfectly mature, 5½ inches long, and of a dark

---

[17] Alaska, p. 272.

[18] As above.

[19] F. B. A., I, p. 224.

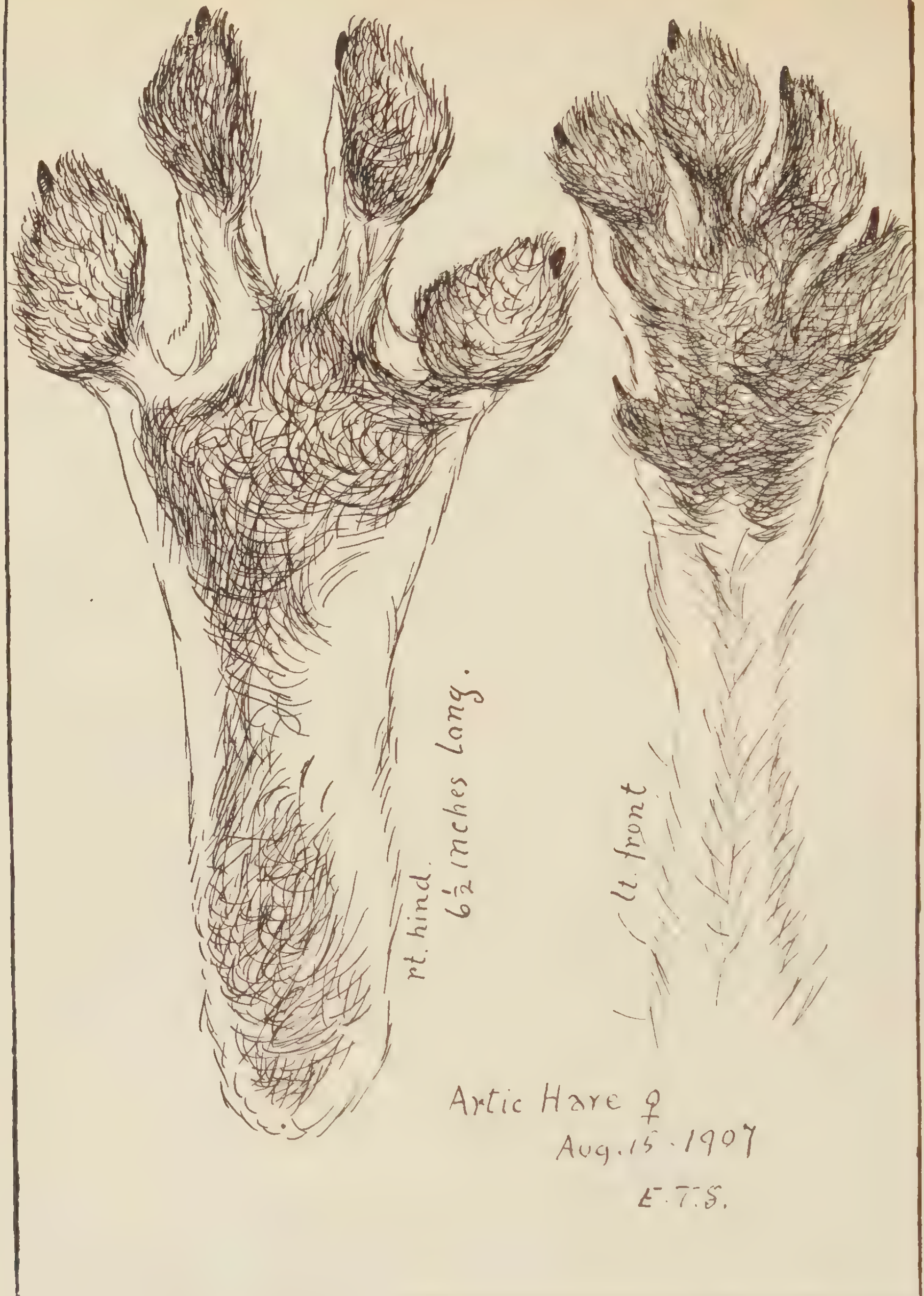


Plate LXXXVII - Feet of Arctic Hare. 1/1 gray colour. In one shot by us in Igloolik, on the 2nd of June, 6 young were found, not quite so far advanced.[20]

On the Arctic coast, near Bathurst Inlet, June 10th, D. T. Hanbury's party secured a Hare that "in a fortnight would have given birth to 5 leverets."[21]

The young are found among the stones of the old Hare's favourite haunts. No one as yet has reported on the nest, so we must suppose that, like its relatives farther south, it makes none.

It is evident that there can be but one brood a season.

TAMABLE

If taken at this early age, the Arctic Hare, like its European cousin, is quite tamable. Nelson writes: "During one winter at St. Michaels, my friend, Mr. Rudolph Neumann, had one of these animals for a pet. It was kept in the dining room at the fort, and became quite domesticated. It was very mischievous, and would sit up before a person and beg for food; and if ignored, would attract attention by striking one's legs with its fore paws. Owing to being teased, it finally became ill-tempered, and would strike one's hand a painful blow with its fore foot when displeased. Eventually, it came to a tragic end, as seemed to be the fate of all pets reared about the Fort."[22]

A still earlier and perhaps more interesting case is given by Capt. J. C. Ross. "One taken by us," he says, "on the 28th of June a few days after its birth, soon became sufficiently tame to eat from our hands, and was allowed to run loose about the cabin. During the summer, we fed it on such plants as the country produced, and stored up a quantity of grass and *astragali* for its winter consumption; but it preferred to share with us whatever our table could afford, and would enjoy pease soup, plum pudding, bread, barley soup, sugar, rice, and even cheese with us. It could not endure to be caressed, but was exceedingly fond of company, and would sit for hours listening to a conversation, which was no sooner ended than he would retire to his cabin: he was a continual source of amusement by his sagacity and playfulness, until in the middle of winter, when playing some of his pranks, he struck his head against one of the beams, and was ever after, subject to fits. He lived and thrived nevertheless throughout the winter, and died in the following summer after 15 months' confinement."[23]

---

[20] Nat. Hist., 2d. Voy., p. xvi.

[21] Sport and Travel in the Northland of Canada, 1904, p. 161.

[22] Alaska, p. 272.

[23] Nat. Hist., 2d Voy., p. xvi.

Not much blessed with brains is Ookalik, if we compare him with Fox or Wolf, but shows a lovely harmlessness. He will not bite, even in self-defense. Mild is he as his big, soft, liquid eyes; and if he be taken young—so young that he has not learned the bitter lesson of Man's inhumanity—his native gentleness appears, as we have seen, and shapes his every way.

HUNTING

Shy though this creature be, "it is not difficult to get within bowshot of it," says Richardson, "by walking round it, and gradually contracting the circle—a method much practiced by the Indians. In the late boat-voyage along the northern coast, we landed on a rocky islet, off Cape Parry, which, though not above 300 yards in diameter, was tenanted by a solitary Alpine Hare. The whole party went in pursuit of this poor animal; but it availed itself so skillfully of the shelter of the rocks, and retreated with so much cunning and activity from stone to stone, that none of us could obtain a shot at it, although it never was able to conceal itself from our search for more than a minute or two at a time."[24]

The Eskimo, neglecting no chase that promises meat, sets snares for the Hare, and hunts it with arrow and bow. At least, he did at one time. Now, it seems, he has adopted the white-man's weapons and the white-man's way. He hunts the Hare exactly as we do the Whitetailed Deer. He tracks it in the fresh snow, and shoots it on the run, when it springs from its lair—that is, if he can get near the Snow-child. Usually it takes alarm at the sinister approaching form and "starts off at a run before the hunter gets within gunshot, and the latter follows at a slow trot upon his snowshoes. This is frequently kept up for a half dozen miles, or perhaps more, until the Hare becomes exhausted, and finally allows the hunter to get within easy range and secure the prize. At other times, the hunter's breath is exhausted first, and he returns home minus the Hare. I may say that this was usually the writer's experience."[25]

HIS WAY OF LIFE

Autumn must be a happy time for Ookalik, the great White Hare. The snowy owl and the falcon are gone; or, if they linger, there are long dark nights in which the Hare can go forth in spite of them, to feed and frolic. The Wolves and Foxes are well fed on small stuff, such as Mice and Lemmings, or on young Caribou; they are too fat to run, and too unhungry to try. There is just enough frost for a pleasant tang, and these to the Arctic Hare are halcyon days.

---

[24] F. B. A., I, p. 222.

[25] Nelson, Alaska, p. 272.

But the ever-deepening snow and fiercer frost are bound to put his endurance to the test, when the Long-Night Moon, the Christmas Moon, is over the broad, white land. Now the Wolf and the Fox are hard pressed for food. Now are they in hunger-trim and training, and the White Hare dare not sleep in a hole. He must be ready at any moment, to make a clean dashaway when the faint warning sound of foot-craunched snow is caught by those big, wonderful ears—double-sensed, tuned and keen as much for vibration as for sound. His bed is out on the open stretch where the Arctic blizzard bites the hardest. But the blizzard he loves not, any more than you or I; and in the severest winter weather, he seeks the friendly cover of willow thickets on hillsides, alder patches in sheltered ravines, or in other comfortable situations. But in all other times of Arctic fine weather—that you or I would consider a frightful frost with stinging wind—he lives content and safe on the wide and windswept plains of desolate snow—the only vital thing, perhaps, to tell the traveller that this is not wholly an abode of death, that Nature has equipped at least one warm-blooded, bright-eyed being to live and prosper in the Realm of Old Jack Frost.

REFERENCES

1795—Journey to Coppermine River, by Samuel Hearne, pp. 382–84.
1821—Journal of a Voyage of Discovery to the Arctic Regions, by Alex. Fisher, S. R. N.
1824—Private Journal, by Capt. George F. Lyon.
1829—Fauna Boreali-Americana, by Dr. John Richardson, I, pp. 221–24.
1835—Natural History, Second Voyage, by Capt. J. C. Ross, pp. XV, XVI.
1887—Natural History of Alaska, by E. W. Nelson, pp. 271–72.
1909—Rabbits of North America, by E. W. Nelson, N. A. F. 29, pp. 61–67.

LIFE XCIV—GREENLAND HARE

PAGE
Names 682
Description: Size, Weight, Colour 682
Fur 682
Peculiarities of Form, Etc. 683
Range on Land and Sea 683
Abundance 685
Home Land and Migration. 688
Haunts 689
Food—Flowers and Ices 689
Food in Winter 690
Mating and Young 691
Garden of Eden Simplicity 692
Sociability and Voice. 694
Enemies 695
Gait 695
Senses 696
Neither Diurnal nor Otherwise 696
Habits 696

References 697

Greenland Hare, Polar Hare, Glacier Hare, Great White Hare, Alpine Hare of the Danes, White Wool Rabbit, Swansdown Hare

Lepus groenlandicus Rhoads

(L. *Lepus*, a Hare; *groenlandicus*, of Greenland)

Lepus groenlandicus Rhoads, 1896, Amer. Nat., XXX, March, p. 236.

Type Locality—Robertson Bay, N. W. Greenland

In general, distinguished by its great size—largest of all our Hares, except, perhaps, *Othus*—and by being white the year round.

Size. Length, 26¼ in. (666 mm.); tail, 2⅞ in. (73 mm.); hind foot, 5¾ in. (146 mm.); ear from notch in dried skin, 3 in. (76 mm.).

Weight. 7 to 15 lbs., with an average, according to Manniche, of 8 lbs.; that is, this Hare is larger than an Arctic Fox.

Colour. In winter, entirely pure white, except the small, jet-black tips to ears, and the dark eyes.

In summer—that is, mid-May to mid-August—white, but tinged with dusky gray on ears, head, and back.

The young in first coat are brownish buffy or grizzled above, reminding one of their cousins farther south. By the end of August, they are in pure white like the parents.

The sexes are alike.

Fur

When we come to describe the coat of the Polar Hare, we are forced to look around for a new vocabulary. It is not like anything else that is known in the world of Rabbits. The Kansas Jackrabbit has a coat of rain-hair, under which is a slight undershirt of heat-retaining wool; the Mountain Goat has an undershirt of thick, warm jaeger flannels, with an overcoat of rain-deflecting, angle-placed, wind-defying hairs; a young swan is protected with a dense, unbristled down. But the snow-born child of the Polar realm combines all three. He is covered from head to foot, the whole year round, in a deep, dense, wind-proof, snow-proof, cold-proof coat of hair and cotton-wool. To a casual glance, it looks like swansdown; but it has the body, the strength and many other qualities of pure, white wool.

"Amongst the inhabitants of Greenland," says J. C. Ross,[1] "one Esquimaux woman was found who spun some of the beautiful white wool of the Hare into a thread, and knitted several pairs of gloves; one pair of which, notwithstanding the native filthiness of the Esquimaux, came into my possession beautifully white. It very much resembles the Angola wool, but is still more soft."

The nursery fringe or excessive growth of long, silky hair on the lower belly, is well developed—over 3 inches long—and is pure white at all times.

In the spring moult, we learn from Manniche that "the Hares free themselves from loose tufts of hair by rolling in the frozen snow."[2]

Peculiarities of Form, Etc.

Anatomically, as Nelson says, "this is one of the most strongly differentiated forms among the known Arctic Hares of America. Its excessively heavy, wool-like coat of fur, the great development of the claws, and the remarkably long, tapering upper mandible, with the extremely long, extended, slightly curved upper incisors, are characters not approached by any of its known relatives on this continent. . . .

"The stout fossorial claws and long outreaching incisors of this species are evidently developed to assist in obtaining food in a region where the extreme rigours of a high Arctic climate and the dwarfed vegetation on land hard frozen and covered with ice and snow so large a part of the year, make it difficult for rodents to maintain themselves."[3]

These are well-marked specific characters, so, of course, are seized on and used by the extremists as the basis for a new group—subgenus at present but in time a new genus. The museum-mad splitters who follow this fetich are the enemies of zoology; they rob classification of all significance. The logical finish of their mode—and they are rapidly nearing it—is a separate genus for each and every species.

Range on Land and Sea

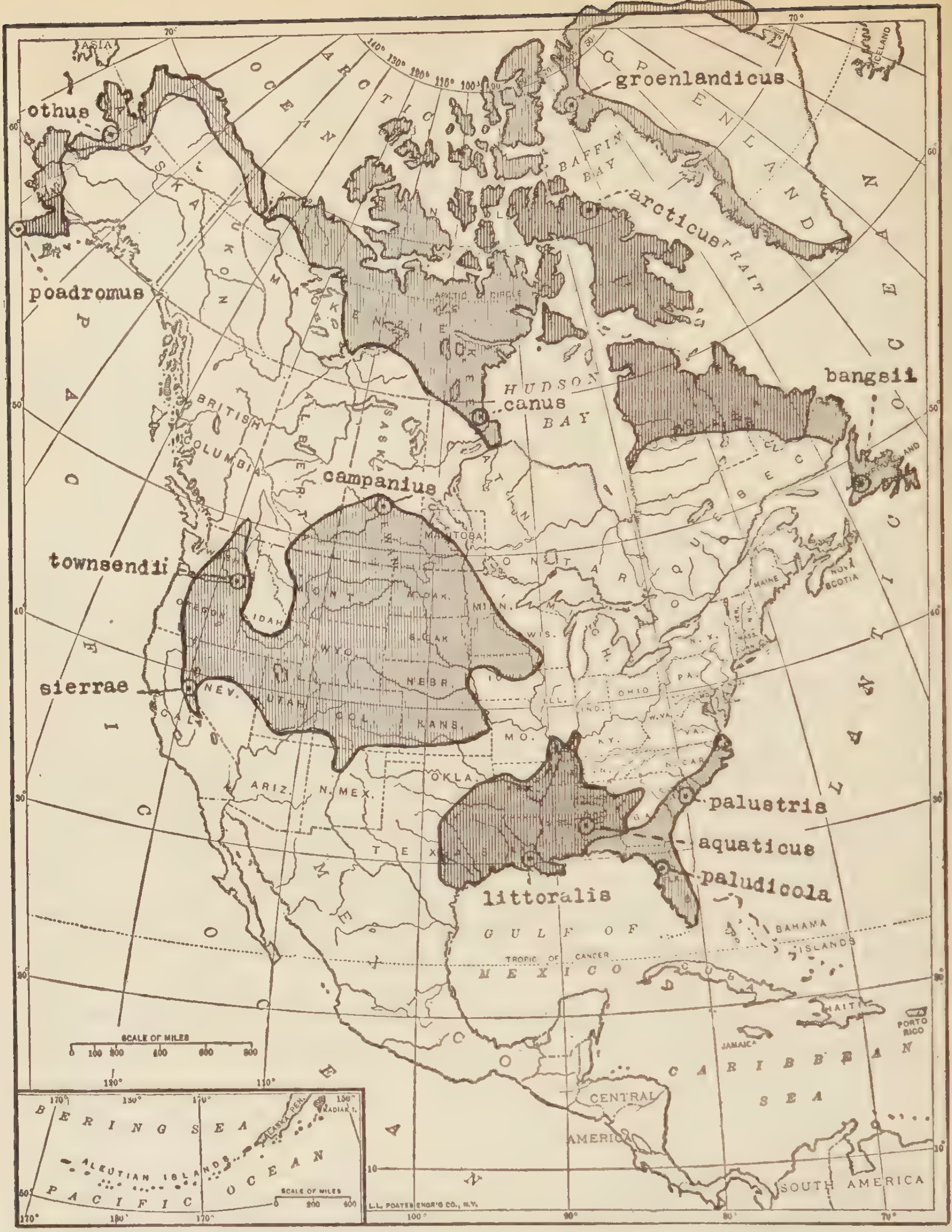
In brief, the range is all of Greenland outside the glacial-cap, and all of the Canadian Islands north of latitude 74°, where there is land free of ice. The following interesting records are in detail of the above.

---

[1] Nat. Hist., 2nd Voy., p. xvi.

[2] N. E. Green, p. 34.

[3] Rabbits of N. A., pp. 68–69.



MAP XVIII.—RANGE OF THE GREENLAND HARE, OF THE ARCTIC HARE, AND ITS RACES; OF THE PRAIRIE-HARE AND ITS 3 RACES; OF THE MARSH RABBIT AND ITS 2 RACES; OF THE SWAMP RABBIT AND ITS 2 RACES

By E. T. Seton, with assistance of the Biological Survey, 1927

Kane says: "We have traced it from Littleton Island as far north as 79° 08'."[4]

Peary found Arctic Hares in North Greenland.[5]

Rasmussen says: "Very numerous" on the north coast of Greenland.[6]

Greely found it common in Grantland, which is the north part of Ellesmere Island, lat. 82°.[7]

Melville Island, Capt. F. L. McClintock got 3 Hares; on Prince Patrick Island, 1; on Emerald Island, 0.[8]

Manniche writes: "This species may—according to existing reports—be considered of comparatively scarce occurrence on the east coast of Greenland, south of 76° lat.";[9] but northward and northwestward, it is plentiful. "Even on the small rocky islands farthest out at sea, as, for instance, Maroussia [5 kilometres from the mainland] and the outer skerries, I [Manniche] found traces of the Hare, showing that they reach these places over the ice; a Hare was shot on Maroussia, Feb. 27, 1908."[10]

ABUNDANCE

It must give every naturalist a joyful thrill when he realizes the abundance of this fine Hare in most of its accredited region. Egede, writing of the species in Greenland (1741), says: "There are also vast numbers of Hares."[11]

Apparently, however, they were overdrawn on; for some hundred years later, Dr. Henry Rink says: "Of the White Hares, hardly 1,000 are taken each year in Greenland."[12] This, of course, refers to the old Danish settlements where they had been "over-cropped"; but farther north, more primitive conditions prevail, and the species is numerous. Thus, Donald B. Macmillan writes, Sept., 1915, 45 miles below Etah: "The green grass at Nerky was fairly dotted with the white bodies of 29 Arctic Hare. Jot squatted on the shore, and, resting his elbows on his knees, killed 5 before they decided that he was dangerous."[13]

---

[4] Arctic Explor., I, p. 395.

[5] Northward Over the Great Ice, 1898, I, p. 490.

[6] Greenland by Polar Sea, p. 298.

[7] 3 Years, pp. 147, 238, *et. seq.*

[8] Voy. of Fox, [illegible], acc. to T. R. Jones, Manual Nat. Hist., Greenland, etc., 1875, p. 498.

[9] N. E. Green., p. 26.

[10] As above, p. 27.

[11] Desc. Green., p. 68.

[12] Dan. Green., 1877, p. 106.

[13] Four Years in the White North, 1918, p. 101.

On the north coast of Greenland, Rasmussen found it "very numerous," "common everywhere," so plentiful that "in the course of a couple of hours, no less than 8" were taken.[14]

On Melville Island, the Polar Hare has always been abundant. On Aug. 15, 1820, Dr. Alexander Fisher "returned in the evening, after a few hours' excursion, with 9 Hares."[15] Aug. 17—"Mr. Fisher was again successful in his sporting excursion bring in 9 Hares, the greater part of which were still beautifully white,"[16] probably meaning that they had been white all summer.

Captain William Edward Parry makes the following summary: "The total quantity of game obtained for the use of the Expedition during our stay upon the shores of Melville Island, being a period of nearly 12 months, was as follows: 3 Musk-oxen, 24 Deer, 68 Hares, 53 geese, 59 ducks, 144 ptarmigan; affording 3,766 pounds of meat."[17]

Captain George F. M'Dougall, who also wintered at Melville Island, announces the following: "Game List, from 3 Sept., 1852, to 9 Sept., 1853. Muskoxen, 114; Reindeer, 95; Hares, 146; Bears, 6; Wolves, 3; Foxes, 51."[18] In both cases, it shows that the Hare was the most abundant of the quadrupeds.

According to Manniche, "the Alpine Hare proved to be very common in the regions which were explored by the 'Danmark Expedition'; at certain places, it occurred indeed so abundantly that it became of economic value for the expedition.

"Besides the considerable number of Hares, which were shot and eaten during the sledge-voyages, not less than some 400 Hares were brought home and consumed on board the ship during the two years it was bound in the ship's-harbour, in the very neighbourhood of which nearly half part of them was secured. . . . At certain seasons, it was by no means seldom to meet with flocks containing 10 to 15 individuals."[19]

McClintock, and Parry too found them in such numbers on Melville Island that they were a godsend; for the flesh is good eating, with little waste and no danger involved. Greely's party had frequent cause to be thankful that Grantland fell within the range of the great White Hare.

This was on the northeast side; but in Oscar Land which is the west side of Ellesmere Island, Sverdrup, in 1900–01–02, found them so abundant as to remind one of the Jackrabbits in California—a prevalence due, apparently, to the absence of Wolves, Foxes and birds of prey. Details of his observations are given under the section on Sociability.

---

[14] Greenland by Polar Sea, p. 169.

[15] Parry, 1st Voy., 1821, p. 250.

[16] As above, p. 253.

[17] As above, p. 257.

[18] Voy. of Resolute, 1857, App., p. 529.

[19] N. E. Green., p. 26.

This condition seems to prevail in all of the Far North. In the extreme northeastern part of Greenland, Rasmussen found the species so abundant that it "played an important part as food for the expedition."[20]

As we go westward into more primitive regions, where the Wolf is rare or unknown, we find the Hares increasing. Dr. E. Bay, who explored the west coast of Ellesmere Island with Sverdrup, says of a certain inlet: "We named the fjord 'Harefjord,' and not without reason. Almost wherever we looked, we saw Hares scampering in all directions. The place was teeming with them. They ran about as if they had taken leave of their senses. It was in the midst of the pairing season, and we supposed they had lost their heads from love. It is a thing which happens to others besides Hares."[21] This was at Blaafjeld, i.e., Grantland on Greelyfjord, about lat. 81, long. 85.

But the most colourful description of the amazing flocks of these snow lambs, is found in Sverdrup's account. He was on foot, exploring along the west coast of Ellesmere Island in 1902; and says:

"I now put on my ski, and set off as hard as I could for camp. Round about me, both before and after I passed the narrow canyon, the slopes were swarming with Hares which were out foraging. When I reached camp at about half-past 7 in the evening, I found the Dogs hard at work gnawing some frozen meat which they had been given. They had made a clean sweep of everything else in the morning.

"I drove on next day at our usual time; again passed the herd at about the same place where I had seen it before, and [we] were soon down through the narrow canyon, although now and again we had to put ourselves, all four, to the sledges to bring them across the stony ground.

"A little farther on, we drove past a Polar herd on the other side of the valley. Some of the animals were standing on the precipice; others were climbing up and down the steep stony slopes, looking like flies on a wall. When we were right under them, they formed up on the precipice, and stood glaring down at us.

"It might be thought that in a country like this, teeming with both ground game and big game, there would also be a great number of beasts of prey, but this was by no means the case; neither in Vendomfjord nor on Troldfjordeidet did we ever see the track of a Wolf. Indeed, everything indicated that the latest "Wolf period" existed in times far back. If ever a new immigration takes place, they will very soon reduce the edible game up here. All these Hare tracks were one of the most extraordinary things I had ever seen; never could I have imagined that their pads would be capable of making such enormous runs.

---

[20] Greenland by Polar Sea, p. 298.

[21] New Land, II, pp. 366–67.

"The farther we went, the more numerous were the Hares; and later in the afternoon, when we reached the lower valley, they seemed to be conjured forth from the slopes as if by magic. There were such legions of them, and they scurried about so in all directions along the valley, and backwards and forwards across it, that the Dogs became absolutely unmanageable. It was impossible to keep them in check; they gave chase time after time; and the Hares themselves were so dazed that they had not the wit to keep out of the way. They did not appear to be afraid; they hopped about only a few yards in front of the teams. At last, after the Dogs had bolted after them time and again, we finally landed in the steep bank of a river. It was impossible for the Dogs to drag the sledges up on to the grass at the top; but as each team was determined to pass the other, the end of it was that the whole caravan stuck fast, sledge by sledge, under the top of the bank, the Dogs themselves just managing to reach the grass. There they sat down on their haunches, and let the sledges dangle down the bank.

"As if to incite the Dogs to the utmost, the Hares came and settled down a few yards from them, and then stood on two legs and stared at us. The Dogs yelped and snapped and made a shocking clamour—and the Hares? They never moved from the spot! What were we to do with them? We had shot quite as many as we wanted to eat, and had no wish to destroy them uselessly, but they had to be got rid of somehow.

"We made up our minds to raid the valley, and clear these tiresome vagrants from under our feet, for it was impossible to drive with the country swarming with them in this way. After a good deal of trouble, we succeeded in driving away the greater number, and were able at last to go on."[22]

As all the Hares are subject to great ebb and flow of population, these various records may have been made at a flood time, and therefore do not give an exact idea of numbers. Doubtless, there are areas, as well as years, in which the species is comparatively scarce.

HOME LAND AND MIGRATION

We have no evidence, except that of analogy, on the home range of the individual. It is probably a mile or so across, as is the case with its near kin of similar size.

---

[22] New Land, II, pp. 181–82.

There is nothing of the nature of true migration among the Hares in general. Millais credits the Mountain Hare (*L. timidus*) of Scotland with quitting the wintry hills to take refuge in the lowlying lands that had more sheltering cover, most of them returning in the spring.[23] In this small and local sense, the Arctic Hare also seems to be migratory. Sverdrup says of the abundant Hares in western Ellesmere Land: "I am inclined to think that it is very usual for the Hares in these tracts to flock together, and change their grounds in the winter months."[24]

Manniche, who studied the species on the northeast coast of Greenland, says: "According to my experience, the Alpine Hare does not undertake real migrations. The Hares which lived in the fells near the ship's-harbour, were nearly stationary all the year round; only in winter, they undertook short excursions to the shore or to adjacent isles, from which they returned sooner or later";[25] migrating over the ice to and from these skerries or rock islands only during the hardest time of winter.

Haunts

According to Manniche,[26] the Polar Hare is a frequenter of rocks, and usually is found on mountain slopes. Only in the severest time of winter weather, when in search of food, does it venture to leave its uplands and descend to the shore-plains. Here the meadows and marshes are partly free from snow, and it can find food; but in case of attack, or when seeking rest, it is ever ready to return to the safety of the rocky hills.

Food—Flowers and Ices

The plains of the North, despite the gloomy pictures conjured up by the word, are lovely with flowers and grasses; so that, during the summer, the Polar Hare has a large and alluring list of foods. Of these, the Arctic willow (*Salix arctica*) is the favourite; but saxifrage (*oppositifolia*), dryas, and rubus are among the staples. However, Manniche relates that a captive Hare would eat white bread, but refused all the plant food offered, except salix and saxifrage as above.[27]

Parry says that on Melville Island, Aug. 11, 1820, "we remarked that almost the whole of the plants had a part of their flowers cropped by the

---

[23] Mamm. Gt. Br. & Ire., 1906, III, p. 36.

[24] New Land, II, p. 46.

[25] N. E. Green., p. 36.

[26] As above, pp. 28–29.

[27] As above, p. 33.

Hares and other animals which are fond of feeding in the sheltered and warm situations afforded by the banks next the sea."[28]

Its favourite foods seem to be the roots and stems of the arctic willow, as we have noted. Manniche describes its mode of securing the roots:

"When, in the afternoon, the Hare begins to feel hunger, it slowly leaves its resting place after a violent yawning and stretching of the limbs; the hungry Hare makes a few indolent jumps forwards on the hill side, and then begins to snuff and scrape for food. This consists essentially of the subterranean, juicy stalks and roots of *Salix arctica*, which the Hare highly appreciates. The animal may, therefore, often be seen busy getting this food, when the earth is thawed up.

"I have often, at a distance of but a few paces, witnessed this interesting work. The Hare selects, by means of the nose, the most promising place; and then goes to work scratching away the upper layer of earth, using its fore limbs with a surprising skill and vigour; thereupon, it makes its way—by means of its nose—to the desired delicacy which it triumphantly hauls up, sometimes in pieces of some 20-30 cm. length.

"Now the Hare sits with a dignified air and half closed eyes—evidently envied by its surrounding companions—enjoying the juicy meal, the long-moulted willow root still hanging out of the mouth like a cigar.

"The energetic masticating motions could distinctly be heard like a weak rustling. Soon the last rest of the willow root disappears, and the Hare again begins to search and snuff; but first it removes the dirt from its muzzle, either by aid of the forepaws, or by rubbing it against the turf or a clump of snow. . . .

"The Hares slake their thirst by taking a mouthful of snow now and then."[29]

Food in Winter

In the winter, although food is still there, the difficulty of finding it is much increased. Here is where the strong, projecting teeth and well-armed paws are of service.

Dr. Kane says of the Hare: "Its structure and habits enable it to penetrate the snow-crusts, and obtain food where the Reindeer and the Muskox perish, in consequence of the glazed covering of their feeding grounds."[30]

In amplification of this, Manniche says: "Crusted snow, through which the Hare is not able to penetrate with the fore legs or the nose in usual way, is forced in the following manner: Having first—by aid of its surprising sharp sense of smell—assured itself where the food can be found, the Hare hammers its fore limbs against the snow crust in rapid, strong beatings, until the crust breaks all over. The animal can then, by aid of its nose and nails, remove the subjacent loose snow, and get at the desired food."

---

[28] 1st. Voy., p. 244.

[29] N. E. Green., pp. 31–34.

[30] Arctic Explor., I, p. 395.

He continues: "I have also seen Hares which, having drummed through the icy snow crust, remove larger pieces of broken ice by means of the mouth, in order to make better room to go on with their work.

"The peculiar sound which the Hare produces by the said beating or drumming against the snow crust, reminds you of distant rolls."[31]

That it makes a continued success of its food hunt is indicated by Greely who, commenting on the 11-lb. Hare which he secured on Grantland (north Ellesmere), says: "Its excellent condition showed that, despite the severity of the weather [15 Feb.], it had found sufficient and satisfactory food, principally buds of the *Saxifrage oppositifolia*."[32]

When other winter foods are scarce, it must, according to Manniche, "be content with moss and withered grass."[33]

Whether it eats the lichen also is not set forth; and so far, it has escaped all charges of carrion-eating, or of cannibalism.

MATING AND YOUNG

The pairing time is given by Manniche as April and the first days of May. He says further: "More or less developed embryos could be found from ultimo May till the middle of June—in a few animals some days later.

"The number of embryos was, as a rule, 6, seldom 5 or 7."[34] Fabricius[35] records 8 in intero. Feilden also mentions a female which "contained 8 young ones." [36]

Manniche continues:[37] "One animal, shot at 'Stormkap' on May the 31st, and, as far as I could judge, a very old one, contained but 2 embryos.

"The . . . Hare, which was caught on April the 30th, died on May the 28th. . . . The animal contained 6 rather developed embryos.

"Leverets of the size of Rats were seen by Lundager on June the 26th at 'Snenaes'; he said that the colour was bluish gray. July the 12th and 13th, I shot two Hares respectively at 'Thermometerfjeldet' and 'Harefjeldet'; both the animals had still plenty of milk in their teats.

---

[31] N. E. Green., p. 33.

[32] 3 Years, p. 147.

[33] N. E. Green., p. 33.

[34] As above, p. 34.

[35] Fauna Groenlandica, 1780, p. 25.

[36] App. to Nares' Voyage to the Polar Sea, 1878, II, p. 204.

[37] N. E. Green., pp. 34-35.

"The young Hares were still of a remarkably smaller size than the old ones; their weight was only 6 to 7 pounds (Danish); while the average weight of the full-grown was a little more than 8 pounds."

Of course, the species breeds but once a year.

Garden of Eden Simplicity

In the land of the Polar Hare, mankind is virtually unknown. We are not surprised, therefore, to learn that "this species was incredibly fearless in almost any season of the year,"[38] according to Manniche. And, further, the flocks of Hares were so confiding "that they—by a proper mode of proceeding—could be treated just as tame animals.

"Thus, I could every day—on the before-named 'Harefjeld' in the neighbourhood of the ship's-harbour—go among the Hares as among a flock of Pigs; I could touch them with the tips of my fingers, get them to eat a willow root, which I held out to them, catch them in a catcher, let them loose again after having kept them in my hands, catch them again a.s.f. all provided, that I did not frighten the animals or make then uneasy by my arrival or by a sudden noise or quick movement. . . .

"If the Hares had once become confident in my presence, they did not care for it later on, and I could make every kind of noise in their presence. I even tried to fire a shot, but this did not impress the Hare flock much; only those individuals which were occupied by chewing, stopped their activity for some few moments."[39]

In apparent contradiction to this is his statement that in "June and July—when the fells are quite bare of snow, and the white animals fully deprived of their natural protection, the Hares showed at this season a remarkable fear of human approach, and sometimes they were so shy, that one could not get them within rifle range."[40]

So also, Dr. E. Bay, who was the zoologist of Sverdrup's expedition, says: "Its behaviour varies much; as sometimes it will allow one to approach quite near to it, while at others, it is a matter of difficulty even to come within reasonable rifle range."[41]

---

[38] N. E. Green., p. 28.

[39] As above, pp. 33-34.

[40] As above, p. 33.

[41] New Land, II, App. III, p. 478.

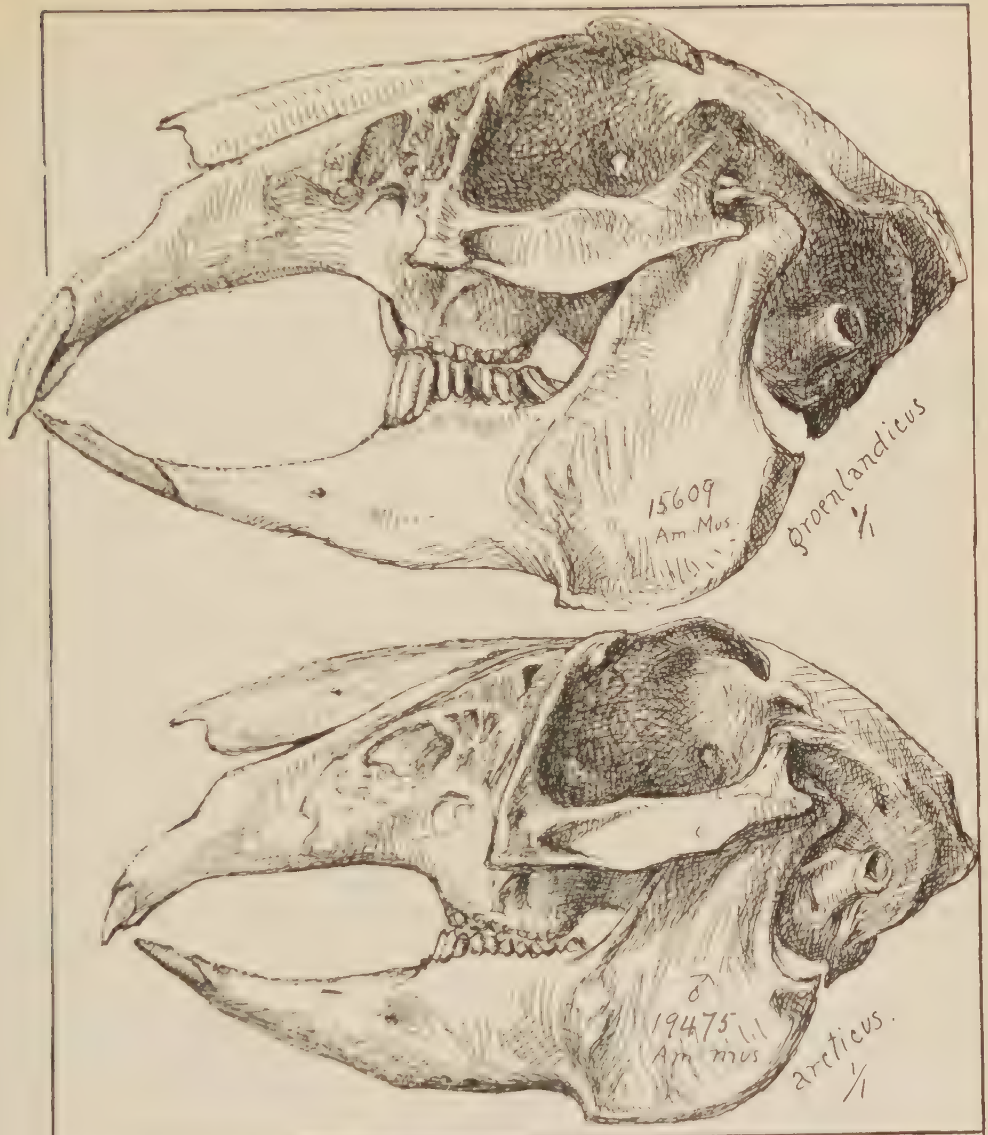


Plate LXXXVIII. Skulls of Hares.
from specimens in American Museum.

SOCIABILITY AND VOICE

More than any other Hare on this list, the Polar Hare is sociable. Thus, Manniche says that its strongly developed sociability is a characteristic of the species. He speaks of Hares assembled in parties of 15 to 20 individuals; and adds that, although in summer, they become shy, they do not lose the sociable impulse.[42]

Sverdrup writes on North Kent Island, between Aug. 14 and 24: "While we were lying to offshore in this way, I one day saw a herd of animals which I thought were Reindeer. . . . but later on, I came to the conclusion that they must have been Hares. At that time, we were not aware that the Hares in these tracts sometimes congregate together in numbers. In this case, there were some 60 or 70 of them, or possibly the number may have been nearer 100. . . .

"Many times afterwards, we saw numbers of Hares together, sometimes in the autumn as many as 30 animals at once."[43]

"On April 27th, on west side of Ellesmere Land [about lat. 79°]," he says, "as I was walking slowly down the slope, I saw a score or so of Hares, sitting nibbling the grass on a little stony hill. I made my way very slowly down towards them, just to let me see how near they would let me come. They soon caught sight of me, and slowly collected. At last, they became an unbroken white mass at the bottom of the hill, where they arranged themselves with their heads inwards and their tails out. There were so many of them that there were several rings, one within the other; and it was a life-and-death matter to be in the most inmost ring—at least, so it appeared to me, for they made the greatest commotion about it. They pushed and fought, and bit each other, till they screamed aloud, all the time slowly revolving, something like a millstone. This was the square of the Arctic Hare.

"After I had watched them for a while at 10 or 12 paces, I turned off round them in order not to frighten them quite out of their wits; and, after I had gone a little way, I saw, on looking back, that they had begun to disperse about the hill, and were browsing again."[44]

By all the rules, a sociable animal should be very vocal; and yet it seems that the Polar Hare utters the same cries as the European Hare—no more and no less; that is, it screams when in dire peril. Possibly it utters a "*qua qua*" when fighting; and the mother may have a soft, murmuring sound when calling her young.

---

[42] N. E. Green., p. 33.

[43] New Land, II, p. 46.

[44] As above, pp. 178–79.

As to its mode of expression, we may repeat Manniche's observations as follows: "Sometimes the grazing animals would snarl at each other, and lay the ears backwards just as snappish Horses.

"At one place, male and female were sitting, licking and scratching each other with their fore paws until they were disturbed by their companions, which were sitting or jumping around."[45]

All sociable animals have games. To this rule, the Polar Hare apparently conforms; at least, the following looks like a game. Manniche says: "While the Hares were searching for food on the side of the fell, or in the more luxuriant ravines, they executed the funniest plays. Sometimes one pursued another a long way on the fell, until the pursued Hare at last performing a high jump, dropped down just behind the pursuer, and then hastened back to the flock."[46]

ENEMIES

"In N. E. Greenland, the full-grown Alpine Hares have, according to my experience, but few enemies to fear. (See *Canis lagopus*, *Canis lupus* and *Nyctea nivea*)."[47]

Condensing many accounts, there seems little doubt that the chief foes of the full-grown Polar Hare are White Bears, White Wolves, and White Foxes. The Wolverine does not figure, because he does not enter the range of the Polar Hare.

The young have a longer list of enemies. In addition to the above mentioned, Ermines, snowy owls, and ravens are forever taking their toll of the helpless young.

Strange to add, man, the destroyer, is last on the list—not because he is ever restrained by any feeling of compassion or by lack of power, but because he simply never, or almost never, gets a chance to attack them.

GAIT

Reference to the various Jackrabbits of the Plains shows that these creatures of mighty hind limbs commonly shoot up in the air, Kangaroo-fashion, to take a look around—that is, they execute a spy-hop. The Polar Hare does the same, but has gone yet farther on the Kangaroo trail.

---

[45] N. E. Green., p. 34.

[46] As above.

[47] As above, p. 35.

Observations made by Greely's party in the north part of Ellesmere Island show that this Hare often travels Kangaroo-fashion on two feet. "Sergeant Rice," he says, "hunting on the 20th [Feb., 1882], shot at a Hare, but did not obtain him. He reported that the Hare travelled for a hundred or more yards at a time by jumping on its hind legs, for distances of 6 or 8 feet, never touching the ground with the fore paws. He said that he thought it at first an optical illusion; but the tracks confirmed his eyesight, showing the hind feet only to have touched the snow."[48]

Similar testimony is offered by Manniche. He says of a flock that he scared away: "In rapid jumps, they hurried up the hillside—never the opposite way—moving on the tiptoes of the hind limbs, while the fore limbs either dangled in the air, or were kept close to the breast.

"The vigilant animals danced among each other—still without using their fore limbs."[49]

SENSES

Manniche, in effect says: "I feel sure that the Hare in dangers, trust more to their sense of hearing and smelling than their sight. I convinced myself, on many other occasions, that the Hare's sight is not very good."[50] This sounds like a paradox, for creatures of the open usually develop wonderful eyesight.

There is much evidence that the ears are of service as vibration antennae, as well as hearing organs.

NEITHER DIURNAL NOR OTHERWISE

In a land where half the year is day and half the year is night, who can say what makes an animal nocturnal? Manniche approaches this complexity in these words: "Though not exactly a nocturnal animal, the Hare always takes the hours of rest at that time of the day when the sun is at its highest. Yet it will begin a meal even in the middle of the day, if it is wakened up or frightened. In the dark period, it seems to have no fixed time of rest."[51]

HABITS

Like all Hares, the big, white, woolly one has a number of forms, in which it finds comfort. They face different ways to meet different slants of wind and storm. They are always in a nook that is sheltered from the wind by rock, bush, or grass on three sides.

---

[48] 3 Years, p. 149.

[49] N. E. Green., p. 31.

[50] As above, p. 31.

[51] As above, p. 29.

Manniche, commenting on this, says: "When resting, the Hare generally sits near a large stone or a low wall of rock, dozing or asleep, sheltered from the wind, and if possible, warmed by the sun. Most commonly, it will choose its seat a little way up a slope, not too near the top nor at the foot."[52]

In one direction, the Hare has gone further than its cousins, for reasons that are obvious. Manniche says: "Through large, not too hard snow drifts, formed in winter, the Hare will sometimes dig long tunnels for shelter; but as a rule, I found it even in the severest winter cold, sitting by its stone without any other shelter than what the stone could afford; and with only that deepening in the snow which was caused by the weight of the animal."[53]

REFERENCES

1741—Description of Greenland, etc., of Hans Egede-Saabye; Eng. translation, 1745.

1780—Fauna Groenlandica, by Otho Fabricius, Hafniæ et Lipsiæ.

1821—Journal of Voyage for Discovery of Northwest Passage (Hecla and Griper), 1819-20, by William Edward Parry. (Herein cited as 1st Voy.)

1835—Second Voyage, 1829–33, by J. C. Ross, Nat. Hist., pp. xv, xvi.

1857—Arctic Explorations, by E. K. Kane, I, p. 395.

1885—Three years of Arctic Service, by A. W. Greely; new edition herein cited, 1894.

1904—New Land, by Otto Sverdrup, II.

1909—Rabbits of North America, by E. W. Nelson, N. A. F. 29, pp. 67–69.

1912—Mammals and Birds of North East Greenland, by A. L. V. Manniche, pub. by Biancos and Liners, Copenhaben, Denmark, as Vol. V. of Meddelelser om Grönland Danmark Expeditionem til Grönlands Nordostkust, 1906–08; pp. 26–36; 6 good photos.

1921—Greenland by the Polar Sea, by Knud Rasmussen, App. by C. H. Ostenfeld, based on notes by Dr. Thorild Wulff, p. 298.

---

[52] N. E. Green., p. 29.

[53] As above.

LIFE XCV—SNOWSHOE RABBIT

PAGE
Names . . . 700
Description: Size, Weight, Colour . . . 700
Races . . . 701
Change of Colour . . . 702
Protective Colour . . . 703
The Snowshoes . . . 703
Range and Haunts . . . 704
Home Range . . . 704
Numbers . . . 705
The Great Rabbit Year . . . 708
The Wipe-out . . . 709
Analysis of the Plague . . . 710
Speed . . . 714
A Strong Swimmer . . . 714
Drink and Food . . . 716
Sometimes Carnivorous and Cannibal . . . 716
Mating and Battling . . . 717
Nest . . . 718
Bearing Time . . . 720
Young . . . 720
Wabasso's Foes . . . 723
Strange Blunders . . . 724
Parasites . . . 725
His Damage . . . 726
A Giver of Meat . . . 726
His Fur . . . 727
Strange Incidents . . . 728
His Personal Habits . . . 729
Winter Life . . . 729
Sociable Instincts . . . 730
The Cry of the Hare . . . 732
Drumming Signals . . . 733
References . . . 734

Snowshoe Rabbit, Common Bush-rabbit, White-rabbit, White-hare, Northern or Varying-hare, Wabasso

Lepus americanus Erxleben

(L. *Lepus*, a Hare; *americanus*, because this was the first American Hare recognized as distinct from those of Europe)

[*Lepus*] *americanus* ERXLEBEN, 1777, Syst. Reg. Anim., I, p. 330.

TYPE LOCALITY—Hudson Bay Territory, probably near Fort Severn

FRENCH CANADIAN, *le Lapin, le Lièvre d'Amérique.*
CREE, *Wah-poos'.*
OJIBWAY AND SAUTEAUX, *Wah-boos'*
CHIPEWYAN, *Kah.*
YANKTON SIOUX, *Mah-steen'-cha.*
OGALLALA SIOUX, *Mah-stin-cha' la.*

Combined with the generic characters, the Snowshoe Rabbit has marked peculiarities of size, etc.

Size. A male taken at Carberry, Man., Nov. 2, 1886, was 18 in. (457 mm.) from snout to end of tail-bone; the head and body were $16\frac{1}{2}$ in. (419 mm.); the tail-bones, $1\frac{1}{4}$ in. (31 mm.); hind foot, $5\frac{1}{2}$ in. (140 mm.).

A medium-sized female shot at Carberry, on the date above, was $17\frac{5}{8}$ in. (447 mm.) in total length from snout to tip of tail-bone; the head and body were 16 in. long (406 mm.); the tail-bones were $1\frac{7}{16}$ in. (36 mm.).

Weight. Two small males were each 2 lbs. 4 oz.

The average weight of 7 females, taken at Carberry in autumn, was 3 lbs. $1\frac{6}{7}$ oz.; the heaviest was 3 lbs. 8 oz.; the above female weighed exactly 3 lbs.

C. M. Oves, writing of the Pennsylvania form, says: "Our largest weighed 5 lbs. and 4 oz.; and the average weight was about 4 lbs. and 5 oz."[1]

Colour. In summer, the typical Snowshoe Rabbit about Hudson Bay is of a reddish-brown above, more or less peppered with black tips to the hairs, especially on the back; becoming clear pale sienna on the legs, and pure white below generally, as shown in Plate LXXXIX (p.702). The upper part of the tail is very dark gray, almost black; the underpart white. The ears are tipped with black behind, and bordered with white in front. (Plate XCIX, p. 756.)

---

[1] Field & Stream, March, 1917, p. 397.

In winter, this Hare is pure white with tinges of brown below the surface, and with the black ear-tips unchanged.

Numerous melanisms, that is black freaks, of this Hare, are on record. I have seen 3—1 in Montreal, 2 in New Hampshire. Thomas Anderson, of Fort Smith, Great Slave River, said that black Rabbits were found in that country. He assured me that such remain black all winter. The Indians avoid killing or meeting these, as it means death to the hunter very soon.

The reverse, a white freak or albinism, is less common. One that I saw in Hine's shop at Winnipeg, was shot near the city in the autumn of 1886. It was everywhere pale buff, and its eyes, as usual in these specimens, were bright pink.

RACES

The following races are recognized:

americanus Erxleben, the typical form. T. l., Hudson Bay.
phaeonotus Allen, paler and buffier than type, darker than *columbiensis*. T. l., Hallock, Kittson Co., Minn.
bishopi Allen, duller coloured than *americanus*, with short, broad skull. T. l., Mill Lake, Turtle Mts., N. D.
virginianus Harlan, largest and most richly coloured; a rusty brown form. T. l., Blue Mts., N. E. of Harrisburg, Pa.
struthopus Bangs, size of *americanus*; ear, longer; colour like *virginianus*, but duller and browner. T. l., Digby, N. S.
macfarlani Merriam, larger than type, with longer ears; a dusky gray form, darkest of all; black on top of tail, and nearly black on rump; feet white. T. l., Fort Anderson, Mackenzie, Can.
dalli Merriam, like *macfarlani*, but paler and more buffy. T. l., Nulato River, Alas.
columbiensis Rhoads, small; dull buffy gray; top of feet, brown. T. l., Vernon, B. C.

bairdii Hayden, like *americanus*, but more dusky reddish-brown; feet, usually white. T. l., Wind River Mts., Wyo.
cascadensis Nelson, much like *bairdii*, but darker and more dusky reddish cinnamon-brown, with rump more blackish. T. l., Near Hope, B. C.

washingtonii Baird, a small, dark reddish form, with little or no white. T. l., Puget Sound.

klamathensis Merriam, like *washingtonii*, but paler. T. l., Head of Wood River, near Fort Klamath, Ore.

(These remarks refer, of course, to summer coat.)

The first 8 forms may constitute one species. The next 2 (*bairdii* and *cascadensis*) may be another. The last 2 may also become established as a distinct species, remarkable for *not always turning white* in winter.

Change of Colour

The old name, Varying-hare, records the fact that it varies its colour with the season. The seasons, in all its proper country, are of two ground colours—brown for six months, white for six; from this, the Northern Hare takes its cue. All summer long, from mid-April till mid-October, it is a little brown Rabbit. Then comes the snowy cold. The brown coat is quickly shed, a new white coat appears, the snowshoes grow fuller—and the little brown Hare has become the Snowshoe Hare of the Woods.*

Most naturalists have assumed that the fur of the animal actually changes in colour. This is not the case. Dr. J. A. Allen, after an exhaustive study of the subject, has demonstrated[2] that the variation is due, not to a change of colour, but to a moult; the brown coat being succeeded by a new coat of white each autumn; this, in turn, being shed in spring, to be replaced by the brown or summer coat. The changes are as regular as the moults of other fur-bearers, and are not influenced by the weather. The order of change in autumn is feet, ears, sides of nose, front of head, rump, flanks, crown, and last, the back. The order is reversed in spring when the creature turns brown.

The most vigorous individuals are first to change, those that are very young or sickly being a week or two later; these sometimes do not turn completely white.

Dr. Allen makes also the following interesting remarks:[3] "Whether or not the soft underfur is also shed in autumn, cannot readily be determined; but from its increased length and abundance in winter, as compared with summer and early autumn, it is evident that, if not wholly renewed, it at least is greatly augmented.

"In the case of the spring moult, there is little doubt that the whole pelage is renewed, the underfur quite as completely as the overhair.

---

[2] Bull. Am. Mus. Nat. Hist., VI, pp. 107–28, May 7, 1894.

[3] As above, pp. 120–21.

*Mrs. Edith Darbey, of Winnipeg, writes me, Oct. 15, 1927, that on Jan. 8, 1927, a Snowshoe Rabbit in full summer coat was brought to their taxidermist studio.

"In the case of wounds from fighting or other cause, resulting in the violent removal of large bunches of fur, it is interesting to note that in the autumn, the new hair comes out white, often weeks in advance of the general change; and that in spring, under similar circumstances, the hair comes out brown, like the summer coat, much in advance of the general change from winter to summer pelage."

PROTECTIVE COLOUR

The protective value of their blended tints, and the way in which many animals turn them to account, raises the question: Are they conscious of their adaptation to surroundings?

Dunham Wheeler writes me, Jan. 7, 1901: "Deer seem to realize their colour; they come to the water to drink, and commonly pause to reconnoitre among dead brush that matches their coat. I am sure that the Northern Hare does so; for in the spring of the year, when they are still in white, and when the snow is in patches, they *invariably* squat or rest on the snow."

R. Nichols, of Portland, Ore., assures me that ptarmigan in white always squat on the snow, if the ground be bare in places.

This does not agree with my own observations on Snowshoe Rabbits and White-jacks. Twice I saw a White-jack crouch on a white rock; but I many times saw them when in winter coat, crouch in brownish, grassy places where they were ridiculously conspicuous. On the bare ground, they are, of course, more visible, and here they were very shy; though this might be explained by the absence of cover.

I am not yet satisfied that any animals actually realize the protective value of their colour.

THE SNOWSHOES

The Snowshoe Rabbit, the Wabasso of Hiawatha, is a wonderful creature, the product of a snowdrift crossed with a little Brown Hare. The terror of the Northern woods is—not cold, there are many ways of meeting that—but deep snow. Snow is the fearful menace, snow that covers up the food supplies, that robs the swiftest of its speed, and leaves it at the mercy of the foes that are winged, or otherwise equipped to follow fast and lay it low.

Nature has tried many means of saving her own from the snow-death. One of these is sleeping till it is over; this is the way of the Woodchuck. Another is storing up food, and hiding; this is the manner of the Wood-mouse. Yet another is stilts—the plan that the Moose has adopted. The last is snowshoes. This is the simplest, most scientific, and best—and the plan of the Snowshoe Hare.

The Moose is like the wading bird of the shore, that has stilts and can wade well for a space, yet soon reaches the limit, where it is no better off than a land bird. But the Snowshoe is like the swimmer, it skims over the surface where it will, not caring if there be 1 or 1,000 feet of the element below. In this, lies Wabasso's strength.

Here are the feet of a Snowshoe Hare (Plate XCIII, p. 719) that weighed but 3 pounds; and here also the corresponding feet of its cousin, the Kansas Jackrabbit that weighs 6 pounds. The latter is at the mercy of the hunter in deep, soft snow; the other skims over it so lightly that none can follow far—it scoffs at all pursuit, even as its thick, soft fur enables it to mock at the raving storm.

Range and Haunts

Map XIX (p. 739) shows the range of the Snowshoe to coincide with the south edge of the Canadian Fauna, and the north edge of the Hudsonian. Nevertheless, its chief abundance is in the Canadian. In the Hudsonian, it is less plentiful, and there looks like a mere overflow from the more congenial woods to the south.

Excepting for a slight loss of territory on its southern border in the Alleghanies and in New England, the range of the species is much as it was in primitive times. It is, moreover, increased through introduction into Newfoundland. Originally, it was unknown there; then implantations of the form *struthopus* were made, and now it is exceedingly abundant.

It is essentially an animal of thick cover, the thicker the better, provided there be some open spaces where it can enjoy a sun-bath. Tamarac and cedar swamps, if not actually wet, are much to its taste. Open forests with nothing but big timber make no appeal to it; but dry copses, varied with open glades, and willow thickets so dense that the Fox, the Lynx, and the Wolf have no chance in open chase, are the ideal homes of the Snowshoe Hare.

Home Range

Each individual has, of course, its own little territory in which its life is spent. How large, then, is the home ground of this free-footed ranger? Marvellously small. It varies in size somewhat with the kind of country, but in very thick, brushy woods, I should think it is certainly not more than 20 or 30 acres; in more open woods, perhaps twice as much. Some individuals, I believe, will even pass their lives within a radius of 200 yards, never venturing outside of this, unless hard pressed by pursuit. The circle that a White-hare makes when a hound is on its trail, is usually around its home range, and thus it shows the hunter exactly where it dwells.

On my own land, I had a White-hare, brought from New Hampshire, that spent all summer within a radius of 100 yards, although free of 100 acres of thick woods. It was easily distinguished by its having but one eye. I could count with certainty on finding it on any morning, in one of three "forms" or beds under the brush; in the evening, it was usually feeding in the open, not far off. I never saw it in other parts of the woods, and all attempts to drive it elsewhere were futile; it merely circled about its own corner. The fact that it was maimed may have limited its range; but I think, nevertheless, that it showed the usual habit of its kind.

Another Snowshoe, on my grounds, passed all its life within 60 or 70 yards of a certain rocky knoll. Its tracks in the winter were found only near this; and in the summer, it was never seen far away. As it was the only White-hare in my woods at the time, the observations are reliable. When chased, it merely dodged about this knoll.

In five or six cases, I had Cottontails and White-hares in a wire enclosure of about an acre. They were kept in for a month; then two large gates in their prison wall were thrown open, but they continued to haunt the same place as though still fenced in. If they chanced to run out of a gate, they would go butting their heads against the wire fence in their efforts to get back to their little home ground.

All of this goes to prove that the individual range of the White-hare, like that of the Cottontail, is very small; probably still smaller in summer than in winter.

NUMBERS

The Hare population of a given area in the Northwest is more variable than that of any other large animal; as the species, more than most others, goes in cycles of multiplication. In some large districts, it increases for a period of years, reaching enormous numbers; just why, is not known, but it is generally believed, that a wave of fecundity sweeps over the race.

But invariably, the year of greatest numbers is followed by a year of plague, which sweeps them away, leaving few or no Rabbits in the land. I should say, then, that Hares were very scarce when there was but 1 to the square mile of woods, and abundant when there was 1,000. I have, nevertheless, seen as many as 10,000 to the square mile.

These periods of increase have been remarked on by every observer in the Northwest. I find the following Rabbit years are on record:

Lake of the Woods region, 1856, followed by plague in 1857.[4]

Upper Assiniboine, 1857.[5]

---

[4] Prof. H. Y. Hind, Narr. Can. Red R. Expl. Exp., 1860, I, p. 119.

[5] As above, p. 284.

Savanne Portage, about 70 miles west of Fort William, 1858–59.[6]

Northern British Columbia, 1872.[7]

Portage la Loche, 1875.[8]

George Grieve, Winnipeg taxidermist, says that 1884 was a Rabbit year in Manitoba along the Ridge two miles west of Reaburn. There, with three others, he shot 147 in three hours.

"At Shoal Lake and Stony Mountain, Man., Rabbits were very abundant, 1883–84. In the spring of 1885, they were found dead everywhere. I saw specimens that were so sick they could not get out of my way. Their necks were swollen and their ears were full of blue ticks."[9]

Warburton Pike says that the autumn of 1885 was a great Rabbit year on the headwaters of the Athabaska.[10]

Red River and Assiniboine valleys, all the poplar country in the basins of Lakes Manitoba and Winnipegosis, Pembina, Riding Mountain, Duck Mountain, and Turtle Mountain, had a great Rabbit season in the winter of 1886–87; followed by the plague in the spring of 1887.

Around Shoal Lake, 1893–94 was a Rabbit year, according to William G. Tweddell, of Woonona, Man.

In the central part of Manitoba, 1894 was a Rabbit year. Dr. D. A. Stewart of Winnipeg, tells me that in the fall of that year "the Rabbits were so abundant along Pembina Mountain that in a 6-mile drive between Altamont and Miami, I saw 35 along the roadside. They were beginning to whiten, though there had been no snow."

In the fall of 1896, Dr. Stewart says that they were fairly plentiful along the Yellowquill trail south of Portage la Prairie; he saw a number lying dead that year. George Grieve gives similar testimony for the Ridge west of Reaburn.

In 1898, though the Rabbits were not very abundant, the plague appeared among them in Shoal Lake Country.[11]

In the whole Mackenzie River Valley, 1903–04 was a marvellous season for Rabbits; their numbers were incalculable. The plague appeared in Jan., 1904, but did not finish its work for over a year. In 1907, I spent 7 months camping in the region without seeing a single Rabbit.

The year 1904 was, to some extent, a Rabbit year in the pine country

---

[6] Hind, Expl. Lab., 1863, I, p. 108.

[7] Prof. John Macoun, Man. & Grt. N. W., 1883, p. 352.

[8] As above.

[9] Dr. J. H. Cadham, personal information.

[10] Barren Ground, 1892, p. 268.

[11] George H. Measham in letter.

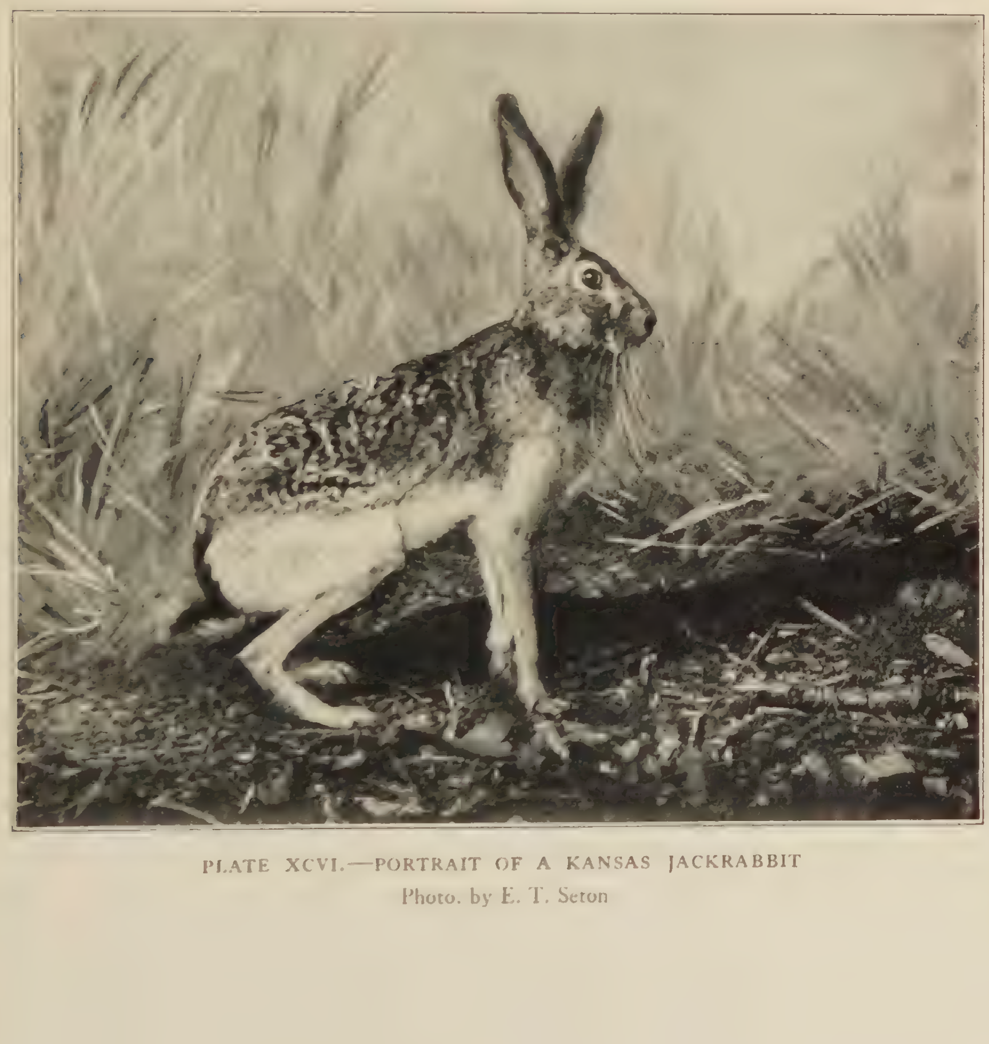


PLATE XCVI.—PORTRAIT OF A KANSAS JACKRABBIT

Photo. by E. T. Seton

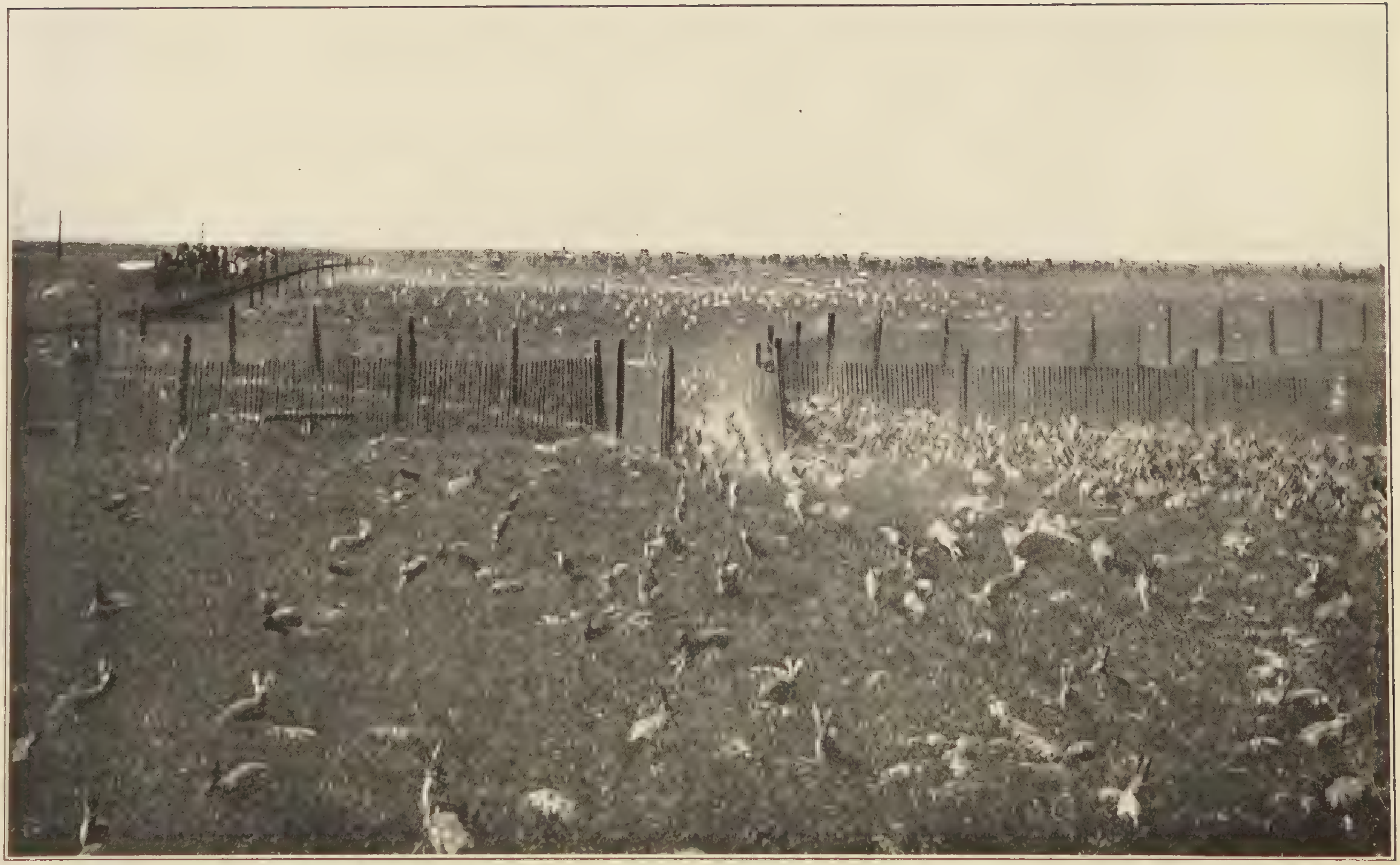


PLATE XCVII.—A CALIFORNIA RABBIT DRIVE

Photograph by H. H. Alexander

of Eastern Manitoba from Whitemouth to Rat Portage, as shown by these notes from my journal:

April 25, 1904, on the railway 25 miles west of Rat Portage (*now Kenora*), *going Westward.* This appears to be a Rabbit year. The snow which still lies on all the shady places is pattered over with their tracks. From the train, I have seen but two or three of the Rabbits themselves. Two were snow white, one was half brown; they were quite conspicuous when sitting on the brown earth. Doubtless a walk in the woods would discover many. The most obvious proof of their presence, seen from the train, is the barking of the brushwood. Wherever a poplar tree has been felled, its top is seen completely barked, the buds and finer twigs devoured. In a less degree this applies also to the birch, tamarac, and willow; their favourite food seems to be the poplar. It is curious, however, that I see few or none of the large standing trees gnawed; the bark near the ground seems less acceptable than that of the fine twiggery. The few standing trees that were peeled were of very small size.

Whitemouth, same day, 11.20 A. M. Though I do not see any Rabbits from the train here, their work is more and more conspicuous. Vast numbers of saplings—poplars, tamarac, black birch, and I think, willows—are barked, evidently done this past winter. I see no Rabbits, doubtless because the country is so wet with spring floods.

Again, going eastward, May 1, 1904. Near the eastern boundary of Manitoba, I saw the first Rabbit. It was now about 6 P. M. During the next 30 miles, I saw in all 38 Rabbits clearly, and close to the tracks. I saw none at all dead, though they would have been conspicuous in the white fur, as the snow is all gone.

As we drew near Keewatin, they were no longer seen; evidently they abound only in a small region about 30 miles across, at the eastern edge of Manitoba.

After this, I saw no more Rabbits until next day in the region along the north shore from Nipigon to Pardee, where, watching for many hours, I saw 5 all told.

All the way from Lake Nipissing to Ottawa I saw but 1.

In September of that same year, I returned to Ingolf with Dr. Gordon Bell and Dr. J. H. Cadham to investigate the supposed plague; but was much disappointed to find how scarce the Rabbits were. In twenty-four hours, we saw 20 odd alive, found 6 dead in the woods, and 6 dead on the railway. This was not enough, however, to prove that the recent scarcity was caused by epidemic. Those taken showed no sign of disease, although thoroughly examined by my two medical friends. In western Manitoba, this same year, they were very scarce.

J. Dewey Soper records that in northern and western Alberta, 1912 was a Rabbit year. On a tract of about 30 acres, he found hundreds of Rabbits. Also, that 1916 was a Rabbit year about Sudbury, N. Ont.[12]

Walter McCoy who camped on the Athabaska with two other trappers in 1913–14, gives a glimpse of Rabbit-year conditions. The men wanted about 500 Rabbit skins to make blankets. He says: "We killed most of them in the door yard—as they came from at least half a mile to a mile around to feed on the tree tops and brush that we used in house (?) building. We could kill 15 or 20, and by the time we had those skinned and the hides cut into strips, there would be as many more again waiting. . . . There were literally millions of Rabbits, so there was no need to save them. They would all die off anyway, and were so thick that they were a veritable pest."[13]

These are the generalizations that may safely be drawn:

A Rabbit year in one part of the country is not necessarily a Rabbit year in another, the condition being local.

An abundance of Rabbits is accompanied by an abundance of birds and beasts that prey on them, especially of Lynxes; and yet the destruction by these enemies makes no perceptible difference.

The Rabbits are wiped out in a single spring by epidemic disease, or diseases, usually characterized by swelling of the throat, sores under the armpits and groins, and by diarrhœa.

The denser the Rabbit population, the more drastically is it ravaged by the plague. Apparently, none are left in the year after the most marvellous abundance.

THE GREAT RABBIT YEAR

In the spring of 1882, when first I lived at Carberry, Man., I could find, perhaps, 2 Rabbits in three or four hours' tramping through the woods. In 1883, they seemed no more plentiful; in 1884, one might see a dozen or more in a morning's walk; in 1885, they were perceptibly more numerous. But 1886, though not a Rabbit year at Lake of the Woods, was the greatest ever recorded in the Western country. The area of abundance began 30 or 40 miles east of Winnipeg, and included all of the poplar country west and northwest of the city, that is all the southwestern half of the Province, excepting the open plains. The abundance that year was prodigious. It so happened that the snow was late in coming (November); yet promptly in October the Snowshoes donned their winter garb of white. So here was the vast brown country speckled and dotted, streaked and crawling, with snow-white Rabbits in myriads. Wherever you looked in scrub lands, it was the same. W. R. Hine wrote me: "In October of this year on the Stinking Water, I killed 75 Rabbits in two hours. I could have killed 500 in a day."

---

[12] Journ. Mamm., May, 1921, pp. 102, 104.

[13] Personal letter, Dec. 3, 1915.

At Carberry, they were even more plentiful. At no time were the near bushes without two or three twinkling ghosts of Bunnies silently flitting by. Many of the neighbours killed a few hundred to lay away for chicken food. I could at any time have killed 50 an hour. They were in similar abundance from Pembina to Pelly, between the Great Lakes, and in all the wooded mountains of Western Manitoba—throughout the Province indeed, excepting in the pine forests and on the open prairies. Apparently, this condition covered not only Manitoba, but the whole range of the Snowshoe species in Canada. So far as records show, this was the first time the entire range was involved in the flood of population.

Near the Spruce Hill, at the edge of the poplar woods, Carberry, Man., I stood; and looking round, counted the Rabbits within a radius of 30 yards. They numbered 11, and there must have been many that I did not see; so that 20 would be a safe number at which to put them; that is, 20 to the acre. But, dividing it by 2 to allow for the sparser places, it would easily total 5,000 to the square mile.

This would give us over 100,000,000 in Manitoba alone—and on the whole 4,000,000 square miles of choice Rabbit range, such count would yield some 20,000,000,000 of Snowshoe Rabbits.

It was a glorious feast for the naturalist; there is an inexpressible joy in seeing so much wild life. But the farmers, who knew about the ravages of the Rabbits in Australia, began to have the gravest apprehensions. Where would they stop? At present, the Bunny billions were confined to the woods. But another year of increase might—indeed must—make a change. Already the woods were suffering from the ever-hungry hordes; soon they would be driven forth into the crops. Then farewell to the old-time prosperity, goodbye to the golden grain.

THE WIPE-OUT

But the fear was groundless. Before the winter waned, the plague had stalked through the woods and had done its worst, coming and working mysteriously, silently but effectually.

In Manitoba, the country from Whitemouth to Whitesand, 250 miles long by 150 miles wide, was flecked with the bodies of white-furred Hares. My friend, Miller Christy, who spent 1887 in Manitoba, writes:[14] "On the sides of the line [C. P. R.], as it runs through the wooded country between Portage la Prairie and Carberry, a distance of about 50 miles, the dead bodies of the Rabbits lay literally in hundreds, if not thousands. In some spots, several bodies were to be seen lying near one another; and over considerable distances, a dried, fluffy White-rabbit's body might be seen every few yards, as the train rushed along, lying on the edge of, or close to, the line."

Just so great as were the numbers, was the destruction by the plague. It seemed to have *taken them all.* The summer and fall of 1892, I spent in the same region, and did not see a single Snowshoe. I have heard of one or two areas in Eastern Manitoba where a temporary abundance of Rabbits has been observed since then; but never, in the Northwest, has there been another such Rabbit year as 1886.

In my Arctic Prairies,[15] I have given records and diagrams to illustrate the ebb and flow of animal life; for all species are subject to these changes, although the outstanding example is the Snowshoe Rabbit. Plate XCI (p. 711).

The subject is too vast for treatment in the present volume; moreover, it increases rapidly and becomes more complex—not more simple—as we study it. The reader who wishes to delve into these entraining mysteries is referred to my pages as above for a starting point.

Analysis of the Plague

The next question is one brought forward by Miller Christy in the article referred to: "Why cannot we find in this disease a means of combating the Rabbit-pest in Australia?" Is it not possible that Science may discover a mighty weapon in the virus of the stricken White-hare? The difficulty hitherto has been to bring together disease and pathologist; but an unexpected chance has recently brought about this desirable conjunction.

I had stocked the park about my home with Rabbits—Jacks from Kansas, Snowshoes from New Hampshire, local Cottontails, Prairie-hares from Manitoba. They were in abundance; I could see a dozen Rabbits at least every day. Then, late in the summer of 1903, they began to die, and, in a few weeks, all were gone. The plague had come, and it swept them away. Those found dead appeared to have had their throats cut, but were too far decomposed to be properly examined. All perished but three or four, which

---

[14] Exterm. of the Rabbit in Australia, Zoologist, Nov., 1892, p. 383.

[15] N. Y., 1911, pp. 95–112.

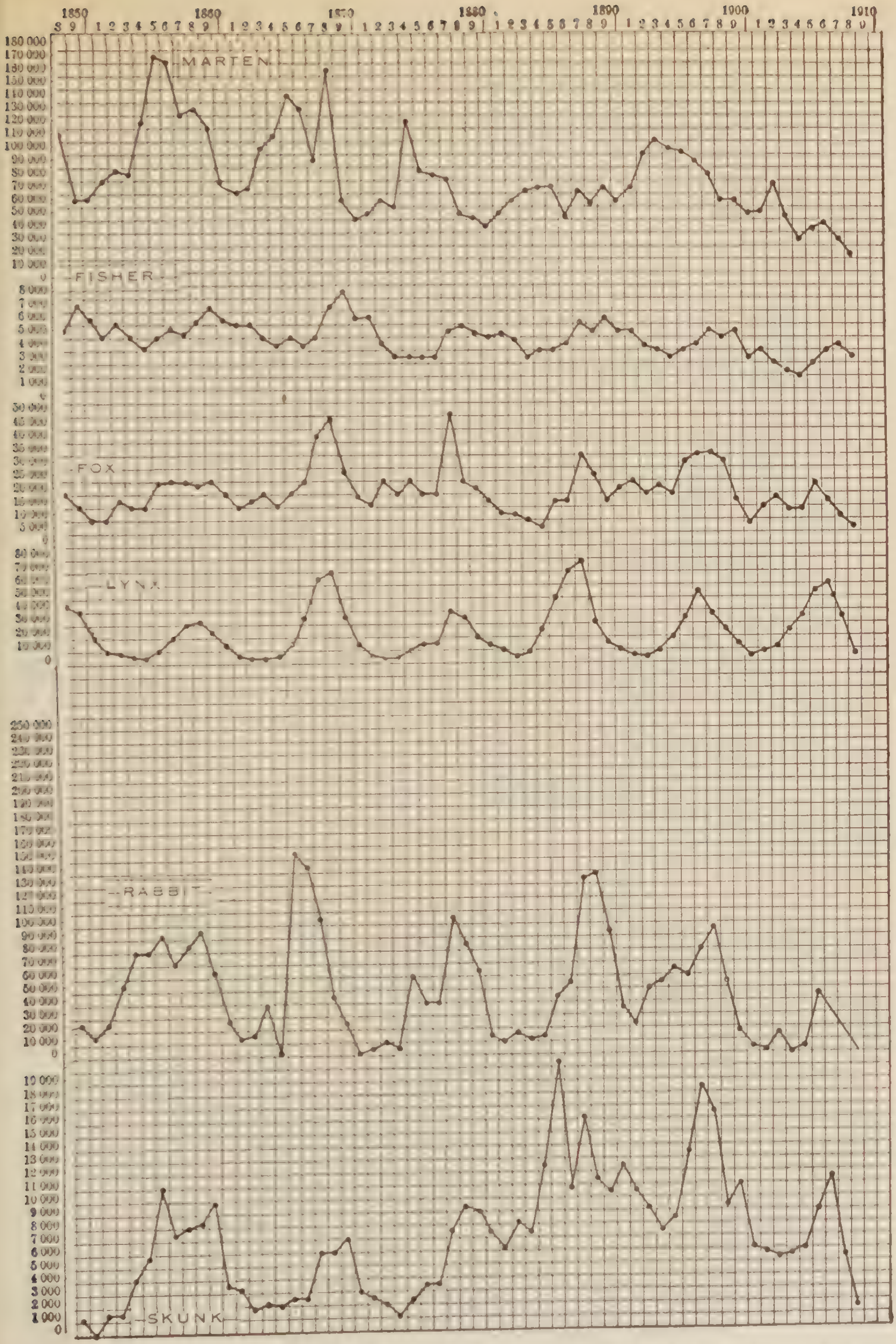


PLATE XCI.—EBB AND FLOW OF RABBITS AND THEIR ENEMIES, AS INDICATED BY THE HUDSON'S BAY CO. FUR RETURNS FOR 60 YEARS seemed very sickly. In the fall of 1904, I at last secured a freshly dead one with its "throat cut" as before. This was shipped to Dr. Seelye Little, of Rochester, N. Y., who, assisted by Dr. Casey, thus reported:

"Animal very thin; ulcerated sores on skin, especially in region of neck and right side of chest; abdominal organs all right; heart and lungs in good condition. There was a large number of enlarged lymph nodes, many of them having undergone cheesy degeneration. These enlarged lymph nodes were in the region of the neck, the right axillary region, and about the lungs.

"Bacteriological examination: Cultures taken from the lymph nodes (the diseased ones) on agar and on bouillon, all showed a pure culture of the ordinary germ of suppurative processes (the staphylococcus *Pyogenes aureus*).

"Cultures from the lungs were negative. Examination for the tubercle bacillus was negative.

"Diagnosis: The Rabbit died, I should say, from a septicæmia due to infection by the staphylococcus *Pyogenes aureus* (the yellow pus-producing coccus that grows in clusters).

"This infection may easily have started in some accidental or skin wound, or possibly in some parasitic skin disease common to Rabbits, and might easily be transmitted from one to another.

"There was no hemorrhagic condition present in the mucous membranes or elsewhere, though that and very extensive changes in all parts of the body (kidney, liver, spleen, etc.) would doubtless have taken place, had the animal lived longer, because the germs were present in the blood and so were carried everywhere.

Two unfortunate Snowshoe Hares from Maine came in October. Their heads were plentifully beaded with blue ticks; at least a score were hanging about each ear. They died in a short time, and the autopsy showed that they had had still other troubles. Dr. W. Reid Blair, of the New York Zoological Park, examined them and reported:

"Both bodies showed identical lesions, viz.: gastric and intestinal catarrh, with small hemorrhages throughout the digestive canal, caused by round-worms. There were two species of parasites present. The stomach worm, which I recognized as the *Strongylus strigosus*, is a most dangerous parasite, since it lives by sucking the blood of its host, and causes death chiefly by anæmia and emaciation. This parasite is blood-red in colour, about $\frac{5}{8}$ to $\frac{3}{4}$ of an inch in length, and marked by numerous longitudinal lines from which it derives its name (striped strongle).

"The parasites were present in great numbers, many hundreds in each animal. The species found in the small and large intestines, I am unable to identify; but, since it is not a blood-sucking parasite, it is less important than the stomach-worms. These worms are ¼ of an inch long, and of the thickness of thin twine.

"The oil of areca nut is the best treatment to reach these worms; and the separation of infested animals and the changing of the runs are important matters."

Dr. W. T. Hornaday, who took part in the investigation, adds: "I examined them under the microscope with great interest. They were present in very large numbers, and the eggs which the *Strongylus* seemed about ready to put forth, betokened reproduction by hundreds of thousands. I think the two parasites account for the periodical seven-year plague among the Northern Varying-hares, and also the Rabbits of the West. The life-history of *Strongylus* is not well known; but it may easily develop that the cycle of this creature's destructiveness is seven years long."

Another specimen which died in the park in Jan., 1906, was thus reported on by Dr. W. Reid Blair:

"Death was due to a generalized infection with tape-worm cysts. These cysts are present in enormous numbers in practically all the tissues of the body, the liver, mesentery, diaphragm, spleen, and pectoral muscles being most involved. A multilobular cyst situated over the ribs on the left side was completely encapsulated by the superficial muscles; on removal, it was found to be about the size of a duck's egg, and to weigh 6 ounces. This cyst contained, besides 4 ounces of clear fluid, about 300 heads of the *tænia*, every one of which is fully capable, under favourable circumstances, of developing into a tape-worm.

"Dogs, Wolves, and Foxes are the mature hosts of this particular species of cysticerci (*Cœnurus serialis*). Rabbits and Hares harbour the cystic form. Treatment of this disease is out of the question."

Another specimen died from tuberculosis of the liver; others were found, but not soon enough for autopsy. At that time, I also lost Whitetailed Jackrabbits from pneumonia, enteritis, diarrhœa, and inflammation of the bowels. Doubtless, the Snowshoes likewise are subject to these complaints. In fact, they seem to have all the ills of the flesh (except possibly writer's cramp and housemaid's knee); and I feel more and more satisfied that the so-called Rabbit plague is not one disease, but many run riot, through the Rabbits being overcrowded and the whole country rendered unsanitary for their species.

It is worthy of note that a number of Belgian Hares also running wild in the park at Wyndygoul, were *immune from the epidemic*. As this Hare is simply a race of the Common European Rabbit, the last circumstance should interest Australians who would import our Rabbit disease.

SPEED

The Snowshoe's safety is chiefly in its speed. It can clear 8 or 10 feet at a bound, and make 4 bounds to a second; that is at the rate of over 26 miles an hour. It has, further, the two advantages of a light creature—it can get up full speed at once, and dodge with marvellous adroitness. But, above all, its faithful snowshoes are there to turn the dreadful snow-drifts into staunch allies.

Like the Jack-rabbit, the White-hare will sometimes make an observation hop, or high leap, as it runs, to take in the situation; but it does not do it so often nor so well as its prairie cousin. Obviously, the act is of less service in the woods than on the plains.

When pursued by the hounds, the Snowshoe first circles around its home range—maybe a tract less than a hundred yards across. But, failing to get rid of them and their clamour, it makes a wide run next time, covering all the country it knows—perhaps half a mile in extent. Outside of that, it is at sea.

A STRONG SWIMMER

Few persons know that this dry-land, fluffy thing can swim. It does not love the water, nevertheless, it does not hesitate to take the plunge when it needs must, and swims well for considerable distances. The following instance I recorded at Carberry, Man., in Nov., 1886:

The frost came suddenly and with great severity this year. The weather had been bright and warm all through the autumn, but a strong north wind, with flying snow, set in on the evening of the 21st. In the morning, the lakes were frozen over for the first time. The ice on them was not clear, but largely composed of floating snow, and there was a thin coat of snow on all the land.

As I crossed a small pond near the south side of Chaska Water, I came across a curious and tragic record—a common Snowshoe Rabbit frozen in, near the north margin of the pond. The marks in the opaque ice showed how it had leaped into the water from the south side, apparently to escape a Fox, had plunged through the weeds, and swum across the open part. But the course grew crooked, showing that its strength was going; and at the north end, near the bank, I found its body hard frozen in the new ice.

Its head and back were out of water and dry, its eyes wide open, its legs spread as though striking out. The entire course it left in the ice was about 50 feet. Thus was the tragedy written out with fullest details in the ice and snow of the earliest storm.

Dr. Merriam records[16] several cases of Hares afloat, thus: "Rabbits are not commonly supposed to swim, but Mr. William Brewster has kindly written me of a case that fell under his personal observation. He says, 'While at Lake Umbagog, Maine, in the summer of 1873, I saw something which may interest you. I was paddling up Cambridge River one warm July morning, when, upon rounding a bend, my attention was attracted by a slight splashing sound ahead, and looking closely, I discovered a Rabbit (*Lepus americanus*), evidently about to attempt the passage of the stream which at that place was, perhaps, 100 feet wide, and at least 8 or 10 deep. He entered the water deliberately, but without apparent fear or hesitation, and was soon beyond his depth and striking out boldly for the opposite shore. A more ridiculous (albeit successful) attempt at swimming can scarcely be imagined. He literally *hopped* through the water, using only his hind-legs, and kicking with such vigour that the whole forward part of his body was raised above the surface at each stroke. Between the strokes he would sink back until sometimes only the tip of the nose was exposed. I fancy that an immense bull-frog, weighted after the manner of Mark Twain's 'Dan'l Webster,' would cut a somewhat similar figure.

"'This method of progression was naturally fatiguing; and before the animal reached the opposite bank, the strokes became feebler and the intervals between them longer, until I began to fear that the tired creature would be drowned. At length, however, he struck bottom, and, loping across a stretch of bare mud, disappeared in the woods. *Such* an appearance as he presented upon emerging from the water!—the lankness of his form revealed by the clinging and bedraggled fur, the ears drooping, and the whole expression one of dejection and shame.

"'None of the guides or trappers of my acquaintance have ever seen a Rabbit swim; although I have been told of an instance where one was observed to take to the shallow water on the margin of a pond, and run through it for several hundred yards before leaping again into the woods. The purpose of this manœuvre was apparent a moment later when a Sable appeared on the Rabbit's track, and following it to the water's edge, lost it there.

"'On the occasion just described, however, no pursuer appeared, nor do I think that *this* Rabbit entered the water under compulsion, or for the purpose of obliterating the scent of his tracks. On the contrary, the action was undertaken so deliberately, that I believe the animal to have been impelled by some idle whim merely—such as a desire to try fresh pasturage, or perhaps to see what the world was like on the other side of the stream. However this may be, the case is doubtless exceptional, for *Lepus americanus* ordinarily has as great an aversion to the water as any House-cat.'"

---

[16] Mamm. Adir., pp. 309–11.

To this, Merriam adds: "Nelson Harris, a well-known Adirondack hunter, tells me that while still-hunting in northern Michigan, a few winters ago, he saw a White-rabbit, that had stumbled into camp and was 'cornered,' plunge fearlessly into a swiftly flowing river and swim to the other side."

In the *Journal of Mammalogy*, May, 1921, p. 108, J. Dewey Soper gives an account of a Snowshoe that, of its own free will, swam the icy flood of Hay River, Alta., where it was four or five yards wide, and going nine or ten miles an hour.

Drink and Food

The young Snowshoe will, as I have seen, drink milk in quantities; but, so far as known, the adult never drinks anything.

Its summer food is grass, clover, and a great many herbaceous things that its nose or its instinct enables it to select without danger of being poisoned. Its winter diet is dead grass, buds, and the bark of poplar, willow, dwarf birch trees, and occasionally tamarac. In some localities, it eats a great deal of white cedar and spruce leaves, so that its taste becomes unpleasantly strong of resin, and on that account is judged unfit for human food.

I find a curious note in my journal which may be a food item:

Aug. 28, 1904. While examining Snake Island in Lake Winnipegosis to-day, I was struck by the quantities of Rabbit dung lodged in every cranny of the rocks that characterize the north side of the island. Each sheltered nook was thickly pebbled over with the pellets; in some places, a bushel might have been collected within a radius of ten feet. It was probably left there in winter, as it had the fibrous woody quality of winter dung. It was far above high-water mark, and could not have drifted there. I suppose that the sheltering rocks caused the Rabbits to seek these places. A remarkable feature of the dung piles was a large mixture of crayfish remains. There were hundreds of claws and leg pieces scattered through them. I cannot account for their presence there. Possibly it was accidental.

Sometimes Carnivorous and Cannibal

Of all our rodents, the Hares are least given to flesh-eating. Yet we know the domestic Rabbit will sometimes eat its own young; and I should not be surprised to find the White-hare at some time showing the morbid taste for meat that it is not supposed to indulge. So I wrote in 1904. The responses to this statement have been many.

Manly Hardy writes: "We caught a Muskrat in a log trap baited with meat quite a way back from the water, and a Rabbit (Hare) in a log trap baited with fish."[17]

Next, Walter McCoy of Washington, D. C., writes me as follows: "In the fall of 1913, I and 2 other persons went down the Athabasca River to about 15 miles below the mouth of the La Biche River. We then went east of the river about 3 miles and built a 'What-not' to live in through the winter. We made 3 Rabbit skin blankets."

His description of the making of those priceless blankets is given in the section on Fur, p. 727. After which, he continues: "Then we simply threw the carcases in piles as so much waste; they made 2 piles about 5 feet across and 2½ or 3 feet high in the middle. They froze hard, and remained so all winter; no doubt, they rotted down the next summer, and made about such piles of skeletons as A. S. Barton describes. The relatives of these Rabbits that we killed, came and gnawed and ate away all the outside of these frozen carcases. They seemed to be especially fond of the paunch and intestines, but they also ate the hams and other fleshy parts as well. In addition to being cannibals, they gnawed at Fox and Weasel and Otter carcases that we threw out. I also saw signs of them gnawing at the dead bodies of such Rabbits as had died of disease and accident in the woods.

"It was not on account of starvation that they were forced to cannibalism, for there were all kinds of brush, and in places, grass, etc."[18]

J. Dewey Soper tells of the Snowshoes demolishing an Ermine trap to get at the meat bait, though it was the hindquarter of one of themselves. He says: "The flesh of one of their own kind is fully as acceptable as any other. Frozen meat they seem to prefer. When one of their number is killed—say by a rifle ball—and left lying, the living of the locality turn to, and make a sordid repast. They start from the wound by licking away the blood, gradually nibbling the flesh and tearing the fur back. I cannot recall ever having seen a perfect body molested, such as one taken from a snare."[19]

MATING AND BATTLING

The mating season is about the first of March. What their marriage customs are, has not yet been ascertained. While many observers consider the Hares promiscuous, or polygamous, there is some testimony that tends to clear the species from such charges.

---

[17] Forest & Stream, May 28, 1910, p. 850.

[18] Personal letter, Dec. 3, 1915, Washington, D. C.

[19] Journ. Mamm., May, 1921, p. 107.

A good father generally means a good husband, and it is strong evidence in favour of their true monogamy when we find the male animal fighting in defence of the young. It points toward pairing, as distinguished from promiscuity, when the male fights in defence of the female. It is, further, a disproof of polygamy when two males live peaceably together in the presence of females during the mating season. All of this we can find in Bachman's description of some White-hares that he kept and bred in captivity. "The old males at this period," he says,[20] in describing their family life, "seemed to be animated with renewed courage; they had previously suffered themselves to be chased and worried by the common English Rabbit, and even retreated from the attacks of the Gray-Rabbit; but they now stood their ground, and engaged in fierce combats with the other prisoners confined with them, and generally came off victorious. They stamped with their feet, used their teeth and claws to a fearful purpose, and in the fight, tore off patches of skin, and mutilated the ears of their former persecutors, till they were left in undisturbed possession of the premises."

No one who has not seen two buck-Rabbits fight, can have the slightest idea of the devilish, deadly ferocity exhibited by these mild-looking creatures. After but little dodging and sparring, they clinch; each seeks to seize the other by throat or jaw or any place to rob him of the use of his own teeth. Then the assailant flings himself on his own back or side, and endeavours, with all the mighty force of his hind feet and claws, to rip open his enemy's belly. The fur flies—the blood flies—the long claws rip into the unprotected front, slash through the skin, and in three or four minutes—unless one gets away—the other is tearing out his victim's bowels—the fight is over!

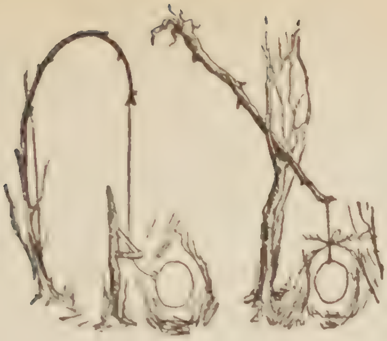
Nest

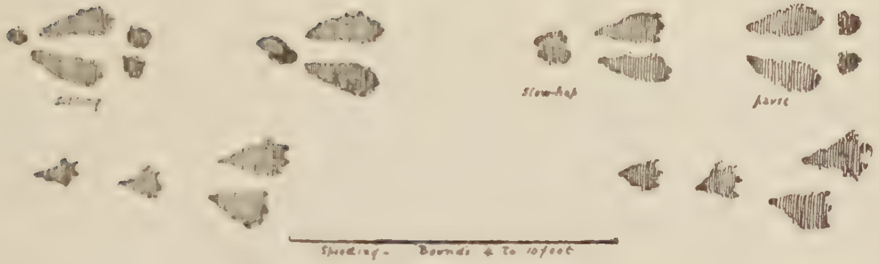
I have never seen the nest of the Snowshoe Rabbit. According to some observers, it is usually made in a sheltered place on the ground, under some brushwood or tangle of dead and living herbage, and is admirably concealed. Nevertheless, I cannot find an account of it by anyone who has actually seen and examined it, with the exception of Bachman, whose captive Snowshoes bred in their paddocks. Two of these females produced young which "were deposited in a nest of straw, the inside of which was lined with a considerable quantity of hair plucked from their bodies."[21]

---

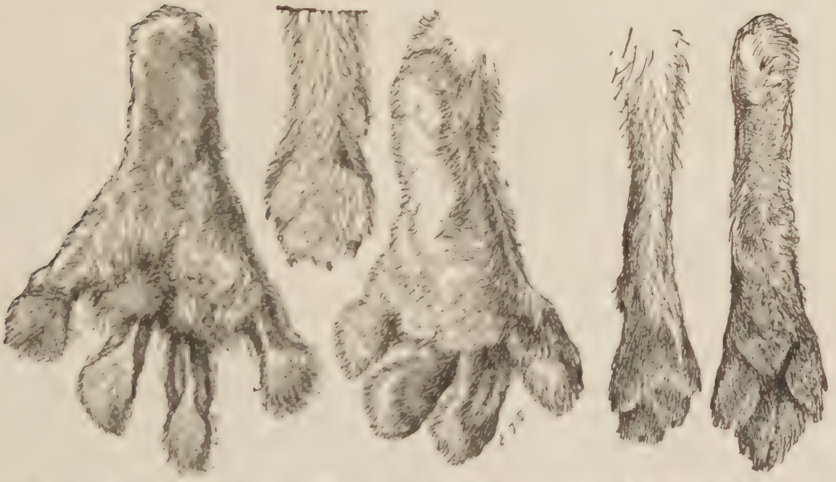
[20] Q. N. A., I, pp. 98–99.

[21] As above, p. 98.





Tracks of the Snowshoe-rabbit.



Feet of Hares, half life-size. The three at left illustrate the Snowshoes of the *Lepus americanus*; the two at the right the feet of Kansas Jackrabbit (*Lepus melanotis*), which weighs twice as much

PLATE XCIII.—DETAILS OF SNOWSHOE RABBIT

Percy H. Selwyn, of Ottawa, tells me that in Brandon Hills, Man., June, 1887, he found some young Snowshoes nesting in a hollow poplar stump.

It is well to remember that the Jackrabbits, its near relatives, make no nest whatever. Probably, therefore, the same will prove true of the Snowshoe in its wild state.

Bearing Time

The period of gestation is probably 30 days, as is the case with the European Hare, but I have no direct evidence. On April 10, 1882, I shot a female White-hare at Carberry (that is, where Carberry came afterward), which contained 2 very small embryonic young. They were probably of two weeks' development, and due to be born late in April. Litters are produced all through May, and even as late as the first week of June.

Dice says: "On July 25, 1911, half-grown young were numerous at Tanana. Aug. 2d, a female containing 6 large embryos was taken at Fairbanks. At the head of the North Fork of the Kuskokwim, a female containing a number of formless embryos was taken May 3, 1912; and one with 3 embryos, each about 110 mm. [$4\frac{5}{16}$ in.] in length, on May 15th. May 29th, a juvenile about one-third grown was seen. A female with 6 large embryos was taken June 24th on the Kuskokwim-Minchumina portage."[22]

Young

The young are usually 2, sometimes 3, in number. Cases are on record of 4 and 6. C. W. Nash tells me that he once found 7 embryos in a female of this species. R. MacFarlane contributes an item of exceptional interest. "A litter," he says, "usually consists of 3 or 4; but when on the periodic increase, females are known to have as many as 6, 8, and even 10 at a time, and then gradually return to 3 or 4."[23]

According to all testimony, the young are born with eyes open, and are covered with very fine, close hair.

The males of those that were bred in captivity by Bachman[24] "did not evince the vicious propensity to destroy their young, which is observed in the domesticated English Rabbit; on the contrary, they would frequently sit beside their little family, when they were but a day or two old, seemingly to enjoy their playfulness and to watch their progress to maturity."

These young ones "left their nest in ten or twelve days and from that time seemed to provide for themselves and to derive little sustenance or protection from their mothers."[25]

---

[22] Journ. Mamm., Feb., 1921, p. 28.

[23] Mamm. N. W. T., 1905, p. 740.

[24] Q. N. A., I, p. 99.

The following notes by Mrs. Mildred B. Caldwell, furnish new light on the Snowshoes' babyhood.

"Friday, June 5, 1925. Five baby Snowshoe Rabbits were found under a pile of boxes at Camp Miramichi, Merrill, N. Y. They measured about 5 inches in length, and weighed perhaps 3 or 4 ounces; were still nursing, and quite wobbly on their feet. Three out of the 5 had a white line down their foreheads, of varying lengths, from ½ to 1 inch. On Saturday, one had disappeared, and we barricaded the little den against Foxes, as a track had been discovered near by.

"We were anxious to tame them, so I gave them forced feedings of milk, water, and a touch of sugar, from a bottle with a bit of linen tied over the mouth. They learned to draw out the milk, but with little enthusiasm; so we judged the mother must be caring for them, although we had never seen a trace of her at any time of the day or night. On the third day, the largest and strongest one disappeared, and we feared for its safety. But late that night it was snuggling in with the others in the smallest possible space; apparently he had been taken out for a day's jaunt.

"That night, we decided to find out definitely just when the mother Rabbit came, if at all; and we banked the entrance of the den with damp sand. The next morning told the story of the mother and her behaviour with the babies. Large Rabbit tracks were found crossing in front of the entrance, not nearer than 10 inches; in the entrance itself a myriad of wee tracks as the babies had come (apparently by signal) to their mother, and had done their nursing outside.

They were such funny, sweet-smelling things, with the fragrance of balsam clinging to them. Their little faces were so broad and whiskery, with just little bits of ears, giving them a strange human look."[26] (Plate XCIV, p. 726.)

My impression is that when the young are about two weeks old, they leave the home place and never return to it. Then and there the family is scattered. They are now independent of the mother's care, and are seldom seen near her. I never expected to hear of a mother Hare followed by her brood, so was much interested in an exceptional case observed by D. R. Hanford, of Duluth, Minn. His record contains more than one surprise:

"Two years ago this June," he says, "while trout-fishing on French

---

[25] Q. N. A., I, p. 98.

[26] Personal letter, July 7, 1925.

River, a stream some twelve miles from here, I saw a mother Hare, coming down the trail, followed by 4 young ones, half or two-thirds grown. Upon killing the mother, we found 2 young ones, fully developed, and about ready for birth."[27]

On June 21, 1883, I was seeking for birds' nests in the Carberry Spruce forest (Manitoba). A white-throated sparrow was chirping plaintively near, and I was peering into every likely place for the nest; when under a brush pile, I saw a young Hare crouching as still as a moss bump. I cautiously reached down through the branches, and caught it, whereupon it squealed vigorously. An old Hare, doubtless the mother, came running through the woods. She rushed about in distress, keeping at a distance of fifteen or twenty yards, but seemed half-disposed to attack me. The little one ceased squealing when put in my pocket, and then the mother disappeared.

The place where it had been sitting was a mass of twigs, but I think not a nest; no sign of fur or lining was to be seen there, nor were any brothers visible; besides, it was now a quarter grown, evidently old enough to run with its mother. Judging its development by that of the domestic Rabbit, it was about three weeks old, and therefore born about June 1.

On Sept. 7, 1902, in the Bitter-roots of Idaho, I caught another half-grown Rabbit in the same way, but saw no parent.

The mother Snowshoe has never been recorded actually fighting for her young, but most of the family are known to do so; and as a hint of what to expect on fuller observation, I add some paragraphs by James Edmund Harting on the common Wild-rabbit (*Oryctolagus cuniculus*) of England:

"In Oct., 1891, a game-keeper in the service of Mr. Deacon of Southborough, Tunbridge Wells, on going through a wood, saw a Stoat which had caught a young Rabbit, playing with it as a Cat does with a Mouse, letting it go and then catching it again. Before the keeper could interfere, he saw a full-grown Rabbit, probably the doe, rush out of some underwood close by, knock over the Stoat, and carry off the young one in its mouth. The Stoat, on recovering itself, followed through the underwood, but presently reappeared in retreat pursued by a couple of Rabbits."[28]

As further evidence, I may say that I have been attacked several times, and bitten as well as scratched by an old doe Belgian hare, whose young I was trying to pull out of their underground nest.

The young of the Snowshoe are usually full grown by autumn, but do not breed till the following spring.

---

[27] Letter of April 24, 1907.

[28] The Rabbit, 1898, p. 20.

They are mature at a year old, and are believed to live for eight or nine years, unless, as more often happens, the Remorseless One removes them as soon as their powers begin to wane.

Wabasso's Foes

A full list of the Snowshoe's enemies would give first place to the plagues already described; next would be a catalogue of all the predaceous birds, beasts, fish, and reptiles in the country. Anything can kill a Hare that can catch it. Its only safety is in its speed among the tangled copses, a speed which, thanks to its snowshoes, is not diminished in the season of stress, but relatively increased. In the open, this is of high order—not enough, perhaps, to save it from a Fox, but sufficient, as I have several times seen, to put Wabasso beyond reach of an ordinary collie Dog. In the undergrowth, however, it is absolutely safe from the open attack of nearly all.

The Hare can dart at speed between saplings that are but three inches apart; it can double around a bush or under a fallen tree, in a way that mocks at the Fox, Lynx, hawk, or owl. But it often falls into their power, when they steal on it sleeping, or when two of its foes unite and so form the "drive and ambush."

These combinations are not pre-arranged, A Fox, seeing another Fox or a Lynx creep into the Hare cover, may lie in wait on some runway without the knowledge of the hunter before him. Even a hawk or owl, I am told, will circle around a Hare home, while a Fox is ransacking its depths, knowing that in the general stampede, there is an excellent chance of good things coming his way.

The Hare has one four-footed enemy that, though much slower than itself, is yet a terror—among the worst of all; and that is the Brown or Ermine Weasel.

I have many times seen the trail of the pair in the snow, showing where the Weasel, with indefatigability that more than made up for its lesser speed, was bounding along the track of some Hare. I have many times heard of the finish of that hunt, but have never seen the actual death.

During the December of 1886, I saw a chase that had a very unexpected end. I was out with a friend hunting in the sandhills north-east of Carberry. The Snowshoe Rabbits were very abundant in the thicker woods, and there were some in an open grove where we halted to feed our Horses. While there, I saw one running about at full speed; and after it what at first I took for a smaller Rabbit in hot pursuit. As it circled in full flight around our sleigh a number of times, I learned the cause of its haste. The smaller one behind was not a Rabbit at all, but a White Weasel, plunging along with tremendous energy through the snow, and evidently running this Rabbit down. The Weasel was winning. He was within a few yards of his victim, when at last the Rabbit, in desperation, took refuge near my feet, under the sleigh; and the Weasel, deciding to be discreet, ran off before I could lay my hands on a gun. There is not the least doubt that the Rabbit feared me as an enemy, for shortly before, it had been running from me. But it did as many others have done in dire extremity; and in this case, at least, proved it the part of wisdom; for a little later, it went its way in peace.

One of the most unlooked-for destroyers of the Snowshoe is the Franklin Ground-squirrel. In the *Journal of Mammalogy* (Aug., 1922, p. 187) Arthur M. Johnson tells of a young Snowshoe killed by one of these unexpected foes. This incident is more fully set forth in the Life of the latter animal, p. 256.

STRANGE BLUNDERS

The white and horned owls are well known as deadly enemies of the White-rabbit. Their annual toll of his numbers must be terrific. He is so defenseless, once they find him in the open, that the owls have no hesitation in pouncing on poor Wabasso. They are so precipitate, indeed, that sometimes they fall into error, as these instances show.

George H. Measham, of Winnipeg, writes me: "I once owned a tabby tom-Cat, a friendly old thief that would follow me like a Dog, when the whim took him. I had occasion to take a walk of about a quarter of a mile from the house one misty evening, just at dusk; and old Tom, feeling like taking a constitutional, came along. There was a little snow, and I suppose Grimalkin's feet were getting cold; so, on turning homewards, he ran on ahead a hundred yards or so. Then, sudden and mysterious in the half gloom, appeared a magnificent snowy owl. Twice he swooped at the astonished Cat and twice reconsidered—that Rabbit was evidently not quite orthodox. A third time the white terror swooped at the quarry, and this time seized old Tom in his iron claws. But—he had caught a Tartar. Tom may have lost two or three of his nine lives in that desperate battle in the air, but, at any rate, he saved the remaining six. Falling on his feet, he made for home at a mile a minute. He was a very quiet Cat for a few days after this adventure. I often wonder what the owl thought about it all."

A still more preposterous blunder is thus related by Manly Hardy: "Some time in the night, while sound asleep, I was awakened by having my head suddenly jerked up; and, on fully awakening, I could feel several places on each side of my head smarting. It was easy to tell the cause. My head was not covered by the blanket, and my hat had fallen off. An owl, mistaking my head for a Rabbit or some other animal, had seized me, and on my speaking, had let go. This is not an uncommon thing, as I have known of several other cases; and Napoleon A. Comeau, in his 'Life and Sport on the North Shore,' p. 422, speaks of knowing several similar instances. In all the cases I have known—some six in all—it was evidently done by mistake."[29]

PARASITES

Deer have bots, warbles, and flukes; Foxes have flies and lice, grouse have ticks and tape-worms. But the unfortunate Hare is harassed by each and all these little pests, as well as by every bird, beast, fish, and reptile of prey that inhabits his country!

No matter what time of summer or fall you examine a Snowshoe Rabbit, you will find firmly attached somewhere about him at least one or two of the blood-sucking wood-ticks (*Ixodes*). I found them on two males taken June 25th; each was decorated with about a dozen. On specimens which I got at Ingolf in Sept., 1904, I found several hundred ticks, varying in size from pin-heads to peas. They were in the ears of the Rabbits; the lower part of the ear in each was clogged with a mass of ticks; none, however, had ventured into the wax-protected inner vestibule. As soon as their host was dead and cold, these ticks loosed their hold, and scrambled in all directions, seeking elsewhere for a renewal of comfort. On October 15th, I received two Snowshoes from Maine; and, on the 22d, two more; all had the ears beaded with scores of blue-ticks.

Plentiful as they are now, I am inclined to think the ticks have been worse, as attested by the following paragraph from Henry's "Journal" on the Red River (p. 180; see Beaver References):

"Ever since April 25 [1801], we have been plagued with wood-ticks [a species of *Ixodes* E. Coues]; and now that we are daily in the woods and grass, our clothes swarm with those troublesome and dangerous insects, which often get into the ear and cause inflammation. When they have time to get firm hold, they cannot be removed without pulling the body from the head, which remains in the skin, and causes an itching which may last for several months. The bellies of our Horses and Dogs are covered with them; they adhere to the flesh until they have sucked themselves full of blood, and are swelled nearly to the size of a musket ball, when they fall off of themselves. Their natural size is about that of a grain of barley, and in shape, they are perfectly flat, with a tough hard skin of a chestnut colour. They continue to the end of July, when they suddenly disappear."

---

[29] A Fall Fur Hunt in Maine, Forest & Stream, May 14, 1910, p. 769.

His Damage

There is not an animal in these Lives that has not, by someone, been declared a nuisance and fit subject for a war of extermination. Either they destroy man's crops, or annoy his Dogs, or harbour disease, or injure his earthworks, or, in some other way, offend him.

What possible harm can be done by the Snowshoe? He is innocent of violence; he is good to hunt and good to eat; he avoids all settlements; he is the embodiment of timidity and harmlessness. So we thought; but now comes the Minnesota forester, and complains:

"The Snowshoe Rabbit is the one principal factor in the loss of a considerable number of planted trees in the forest plantations of northern Minnesota," states Director Raphael Zon, of the Lake States Forest Experiment Station at St. Paul. "The abundance of the Rabbits this year and the damage they are doing, are evident to the most casual observer who visits the cut-over areas of the region, where both State and Federal authorities are endeavouring to make denuded forest land again productive through extensive planting of young pine seedlings." The Editor of *Forest & Stream* comments thus:

"In giving examples of recent damage to support this statement, Director Zon declares that as much as 79 per cent. of the trees in one plantation were eaten off by the Rabbits, 43 per cent. fatally."[30]

A Giver of Meat

The knowledge that the White-hare is so subject to disease may keep many from using the flesh for food; thus exemplifying the danger of a little knowledge. These persons should remember, first, that there is no record of anyone getting disease from Rabbits they have eaten. Second, every kind of human food, whether animal or vegetable, is more or less infested by microbes. If that thought is to weigh, we must never again eat a bite of *anything*. There is no way of saying beforehand which foods are safe and which are dangerous; but we must trust to the general principle that proper cooking will put all these micro-organisms beyond the possibility of doing harm.

The Hare Indians of the Mackenzie were so called because they counted on this Hare as their mainstay in winter. Yet all who travel the Far North country, agree that Rabbit meat is poor, innutritious stuff; it is a mere stopgap in dearth of other foods. One cannot work hard or long on Rabbit meat; and the Indians, when they have none other, say they are "starving on Rabbit."

---

[30] Forest & Stream, Dec., 1924, p. 768.

HIS FUR

Next after the flesh, the skin of Wabasso is of service to man. The hide is too weak and the fur too brittle for its commercial use as a peltry; but the Indians cut it into long strips, and plait or weave these into blankets that are marvellously warm; and that have this advantage over other fur robes—they give ventilation, and so do not sweat the wearer, or become damp during active service. They are very light as well as warm, and in great demand by prospectors and travellers in the Far North. Many a miner, of the few that won on that long, desperate Klondike trail, can truly give thanks, for salvation and golden success to the Snowshoe Hare, from which was pillaged the blanket that kept him alive to win.

Walter McCoy, of Washington, D. C., when wintering on the Athabaska with two trapper friends in 1913, made 3 Rabbitskin robes. He says: "It took about 130 Rabbitskins to make each blanket. We . . . cut . . . the skins into strips about $\frac{3}{4}$ to one inch wide, and 5 to 8 feet long, depending on the thickness of the hide and the size of the Rabbit."[31]

As to the making of these robes, E. A. Preble says:

"The skins are cut into strips, which are twisted, and woven on a frame into a robe of the desired size. The mesh is very coarse, and the fingers may be thrust through the finished robe at any point. The loose, soft fur, however, resists the action of the wind, and on account of their lightness and warmth, these robes are considered second only to those made of Caribou skins, and are preferred by some. To obviate the unpleasant consequences of the shedding of the fur, they are usually inclosed in a cotton case. Capotes, shirts, and mittens made in the same way were formerly in common use, and are still made by some of the remote tribes."[32]

Another interesting use has been found for his fur. The whole kingdom of Wabasso is inhabited by chickadees of one or other species. There must be full a million pairs of these blithe winter sprites in the great North Wilds of pine and snow; and we are assured that each and every one of these was cradled in a nest that was lined and warm with Rabbit fur. They always use it when they can get it, and we are safe to say that they can always get it.

---

[31] Personal letter, Dec. 3, 1915.

[32] Athabaska-Mackenzie, N. A. F., 27, 1908, p. 201.

STRANGE INCIDENTS

During the great rabbit year on the Mackenzie (1903–04), Chief Trader C. Harding, of Fort Resolution, tells me that twice it happened that two Rabbits were taken at once in the same snare; they were coming from opposite directions, and had the luck to arrive at the same time, put their heads in the same noose, and suffer the same fate.

W. G. Tweddell, of Woonona, Man., calls my attention to the fact that sometimes White-hares are caught bearing dermoid cysts in their flesh. These are growths covered with skin, more or less hairy, and sometimes even provided with teeth. The Indians treasure these as great medicine, and call them *Pee'-to-wab-oos-ongs'*—that is, "the little Rabbit within." To pass one of these through a Rabbit snare is, they believe, to guarantee its immediate success. Such cysts are well known, and have already been mentioned in the Moose Life (Vol. III, p. 158).

This same hunter relates another strange case: In Feb., 1883, while hunting with the Chief Metwayash at Rabbit Point Lake, Man., he caught sight of a Snowshoe Rabbit twenty feet up a sloping tree. On examination, it was found dead and frozen stiff, one leg caught in a crotch. He is satisfied that it was not put there by any man, but that the creature ran up, possibly scared by a Fox; then, slipping, was caught and held till dead. This is the first time that he ever heard of a Rabbit climbing a tree.

A singular monument was found on Turtle Mountain, in 1896, by A. S. Barton. While seeking an old Indian camp on a wooded hill, he found several piles of Rabbit skeletons—skulls and other bones complete. The piles were three or four feet across and a foot high. I doubt not these Rabbits were collected by the Indians in time of plenty; they had secured hundreds of them, and left them frozen. In the spring, when the Indians moved away, these were left to rot.

An illustration of the fascinating power of a lantern I find in my journal for Sept. 16, 1904. I was then at Ingolf, Ont.; and during a stay of twenty-four hours, I and two companions saw over 20 live Rabbits in the woods, and found 6 dead on the railway track. These, the station agent said, had been killed by the trains. At night, they get on the tracks, and are so bewildered by the headlight, that they run before the engine until overtaken. Apparently, it does not occur to them to plunge out of the brightly lighted dangerous space into darkness and safety at one side. The figures above show that a considerable proportion may be thus destroyed.

His Personal Habits

"As much wit as a Rabbit" is an old expression of contempt among Red-folk as well as White. The rodents are not high in the order of intelligence, and the White-hare is low among rodents. His keen senses, his wonderful speed, the willow thickets, and finally, his snowshoes, are the reasons he is left alive to-day among countless enemies; for he is not equipped in any degree to battle in self-defence. His speed and fecundity are indeed his holds on existence.

The Snowshoe Rabbit dresses his coat much after the manner of the Cat, and is, in some respect, a model of cleanliness. But he does not hesitate to void his dung in the nest. This violation of the sanctity of the home is a mortal sin, one for which nature makes him pay dear in the end. This may be the very breach by which the dreaded epidemics are enabled to enter in, and work such havoc on the race.

Plate XCIII (p. 719) sets forth the tracks very fully, except that it does not show the 8- and 10-foot bounds that the Hare can make, or suggest the wonderful lightness of his tread on the lightest of snow.

As a rule, the Varying-hare crouches quietly in his form all day; toward sunset, he often moves to some high place where he can sit in the light of the red orb, as though to enjoy the scene. Soon afterwards, he stretches his legs, and hops away to seek his favourite feeding-grounds, remaining more or less active until dawn. He may run about the woods in early evening, but he is very careful, when making a foray on the farmers' pea-fields or gardens, to do it only under cover of darkness.

Winter Life

The life of the White-hare is in the same places, and continues much the same, in winter as in summer. The principal changes are those of coat and of diet.

So far, I have not seen any sign of migration in the species. The individuals that I had in my park, kept the same part of the woods all the year round; and the three or four forms that were their homes when the snow was on the ground, were still their homes in the height of the warmest weather.

I suspect, however, that it has a habit of occasional torpidity. It is well known that the English Hare and the Common Cottontail will lie up, under stress of bad weather, letting the snow drift over them. There they continue several days without eating, and in a semi-torpid state, until aroused by some outside change for the better. I never saw a White-hare doing this;

but from the fact that no tracks are seen for a day or two after a very cold spell, I can readily believe that they share the family habit. In the case of the White-hare on the knoll, referred to in the section on Home Range, his tracks were not seen for two or three days after each heavy snowstorm; and in the spring, we found a lair in a rocky crevice where, no doubt, he whiled away the worst of the weather.

Writing of his hunt after Snowshoes in Pennsylvania, just after the first snow, C. M. Oves says: "It was a bright, sunshiny day, warm and lazy, and every one of the four Snowshoes was under a log, and permitted a close approach—a thing impossible under any other circumstances. Another thing, it has snowed for three days, yet there wasn't a single track leading to or from the log where I had scared the young one. The natives claimed that since it was his first snow, he wouldn't have ventured out till he was almost starved."[33]

Sociable Instincts

The Snowshoe is sociable only in slight degree. These Hares come together when their numbers are such that they cannot help it; and, on the whole, are not benefited by such close association. The only advantages they reap are that the pathways are kept well worn and open; and they notify each other of danger by stamping, by running, or, in extreme cases, by squealing. As a matter of fact, these Hares intercommunicate little but trouble and disease.

Among many human races, there exists a prejudice against moonlight. It is interesting to note that the animals do not share this feeling; indeed, there are many species that make the moonlight nights their chosen time for sallying forth.

J. Dewey Soper describes a moonlight gathering of Snowshoes around his cabin on Hay River, Alta., in 1913. He says: "One sparkling moonlight night, they visited the clearing in unusual numbers. . . . All seemed imbued with a spirit of festive joviality, doubling about with playful pranks and short sallies of wild abandon, but ever and anon returning to the sumptuous feast.

"Observed from the cabin window, this pantomime went constantly on; the revellers seemed never to tire. Some fed, some frolicked as in games of tag; but a rigid alertness never for a moment ceased. Always one or more of the company sat erect on its haunches, alert, ears forward, nose aquiver, sifting the implications of the night. One ominous sound or sign was enough to scatter this merry assemblage to dark and distant shadows. When one

---

[33] Field & Stream, March, 1917, p. 396.

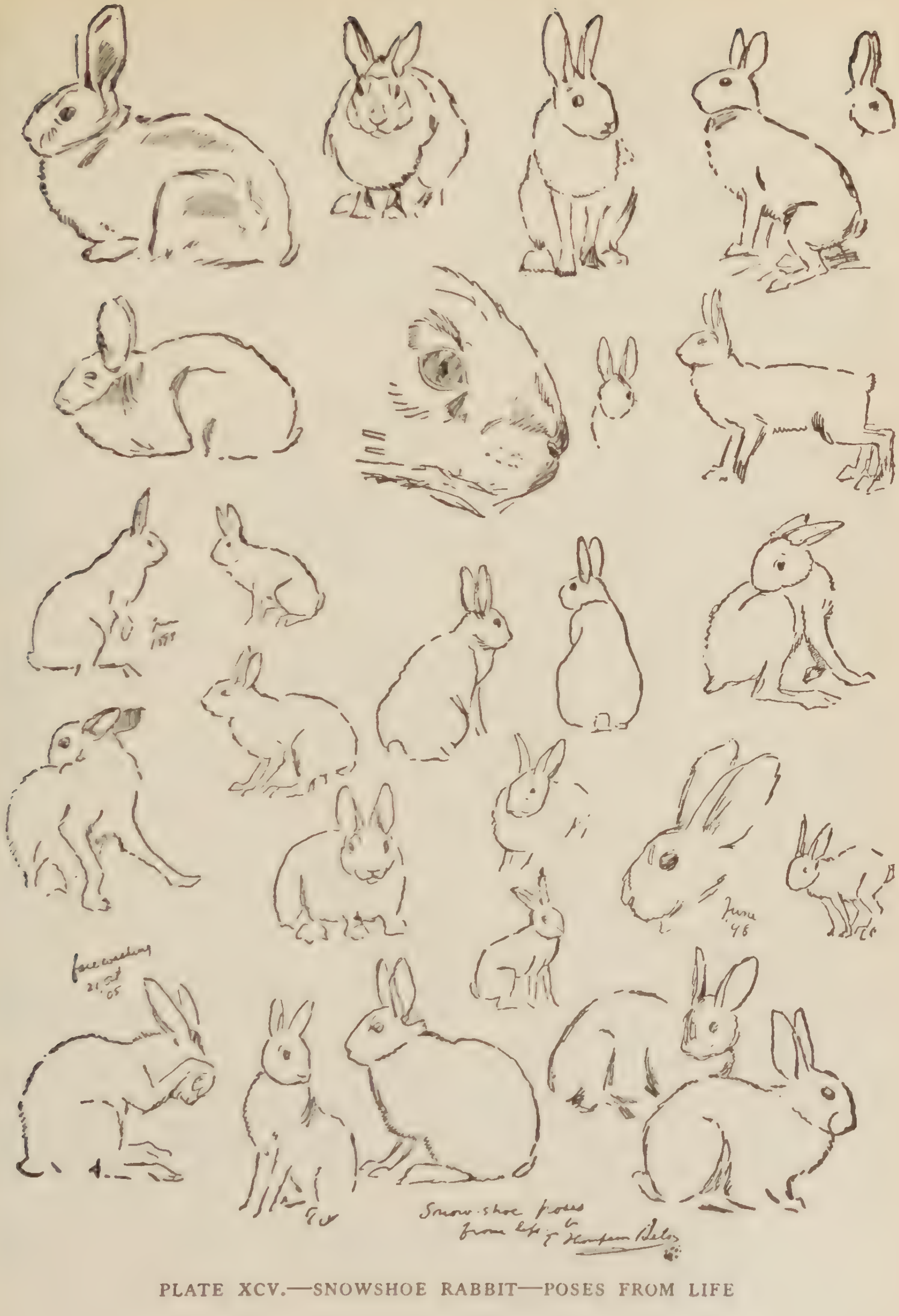


PLATE XCV.—SNOWSHOE RABBIT—POSES FROM LIFE watcher went down, another was already acting as sentinel. Still new arrivals came hastening along the ramifying trails. It seemed probable that the entire Rabbit population within a wide radius were conscious of this regal occasion. At one time, we counted 25 in easy view; double that number were possibly present; some hidden behind the piles of boughs, or in the shadowy outskirts of the moonlight."[34]

On June 25, 1884, near Minnedosa, Man., I saw two Hares chasing each other among the willow thickets. On being "collected," both proved to be males. The energy with which they were engaged, however, was suggestive of battle rather than play.

The Cry of the Hare

I have often heard the White-hare give a loud squeal when in extreme fear, but I think *not* when in great pain. This squealing is uttered also by the Cottontail, the English Rabbit, and the English Hare. The female of the last-named is said to have a soft plaintive call for the young. The Jackrabbit of Kansas, I know, makes a snarling sound, when fighting with its own kind. Probably these cries are also uttered by the Snowshoes.

Since the foregoing was written (1904), young naturalists have increased in the land, and additional observations are opening up new possibilities. G. G. Goodwin, discoursing on the mammals of Gaspé, says: "About 12 o'clock one night, we were awakened by some animal making a peculiar cry in the tent. Getting out a flash-light, we saw a large Hare sitting up in the middle of the floor; after a few minutes' inspection, it leisurely retreated through the entrance."[35]

A still more suggestive paragraph is offered by John Fottler of Boston, Mass. This also was in Gaspé. He says: "Although it was early October, there was about a foot of snow, and the weather very cold.

"The second night was bright moonlight; not a breath of air stirring, and the silence was so intense that it seemed weird and oppressive, bringing a feeling of terrible loneliness.

"Some time during the night, our whole camp was suddenly aroused by cries that apparently came from quite a distance; such wails of agony I had never before heard, and I hope never to hear again. No child lost in that dense wilderness could have so pathetically expressed its misery. Those cries have haunted me ever since.

"We were horror-stricken to hear that rapidly repeated wail of some poor creature calling to God in its dire distress.

---

[34] Journ. Mamm., May, 1921, p. 105.

[35] As above, Nov., 1924, p. 257.

"Our men turned out to investigate. I asked to have someone go at once and release the poor thing, whatever it might be; and two of the men started out. On their return, they reported that a Hare had been caught by one of its fore feet in a snare that had been set the day before; and that this was a full quarter of a mile from the camp."[36]

Drumming Signals

Every child who keeps Rabbits knows that they express anger and some other emotions by thumping with the hind feet. Most of us have seen a tame Hare that would drum on a tambourine at command. But not all of us have realized that these performances are mere hints of the thumping signal-code, that is more or less used by all wild Rabbits.

While camped in the Bitterroot Mountains of Idaho, Sept. 7, 1902, I saw something that looked like a social gathering among the Snowshoes. It was called together by the drumming of a captive. I had secured a half-grown one; and at night, put it under a thin, hard leatheroid box. It soon made the forest ring with a loud tattoo beaten on the box with its forefeet. Again it sounded, *tr-r-r-r-r-r*.

Shortly afterwards, a full-grown Snowshoe Rabbit darted across the open camp space, and into the dark forest again. Another and another appeared, and we heard the alarm *thump*, *thump*, *thump*, in the woods around, and a responsive *tr-r-r-r-r* from the box.

Armed with an acetylene lantern and a camera, my companion, W. E. Bemis, and myself went forth to investigate. As we set the lantern on the ground, a Rabbit rushed into the light, gazed at it, and disappeared. Another came, gazed, gave an alarm thump or two, and vanished. Then two came, then others, then more—a dozen Snowshoe Rabbits, at length, were gazing into that marvellous light. One gave the alarm, and all dashed off. But they came back, and yet closer; and began to caper about in the bright place, and chase each other in play, leaping past the lantern which I held on the ground, and over the camera which my friend was holding.

At length, one of them jumped on the camera between Bemis's hands, and was caught. It shrieked with terror. In a twinkling, every Rabbit had disappeared; and, though we were two weeks longer in that same camp, we did not see another of this species.

---

[36] Forest & Stream, Feb., 1921, p. 78.

References

1849—Quadrupeds of North America, by Audubon and Bachman, I, pp. 93–106.

1884—Mammals of the Adirondacks, by C. H. Merriam, pp. 309–11.

1894—On the Seasonal Change of Colour in the Varying Hare (*Lepus americanus* Erxl.), by J. A. Allen, Bull. Am. Mus. Nat. Hist., Vol. VI, Art. IV, May 7, pp. 107–28.

1905—Mammals of the Northwest Territories, by Roderick MacFarlane, Proc. U. S. Nat. Mus., Vol. XXVIII, p. 740.

LIFE XCVI—BLACKTAILED JACK

PAGE
Names 736
Description: Size, Weight, Colour 736
Races 737
Range and Haunts 738
Home Range 740
The Mating of Lothario 740
The Nest That Has Never Been Seen 741
The Multiplicand 741
How They Grow 742
Play Is the Business of Childhood 744
The Nursing of the Young 745
Solitary and Selfish 746
Communication and Voice 746
Strange Incidents 747
A Rigid Vegetarian 748
The Drink of an Abstainer 748
Protective Colouring 749
The Track—Its Story 749
Enemies—All the World 751
Insects and Other Parasites 752
His Speed—His Way of Life 753
Numbers in Early Days 754
The Rabbit Menace 755
The Devouring Hosts 755
The Big Shoots 757
The Poison Warfare 758
The Drives 758
A Jackrabbit Drive 759
To-day 760
The Final Thought 761

References 761

Jackrabbit, Californian Jackrabbit, Blacktailed Jackrabbit, Gray-sided Jackrabbit, Narrow-gauge Mule, Jackass-hare, Texas Jack, Texan Hare

Lepus californicus Gray

(L. *Lepus*, a Hare; L. *californicus*, of California)

Lepus californica GRAY, 1837, Charlesworth's Mag. Nat. Hist., I, p. 586.

TYPE LOCALITY—"St. Antoine" (Monterey Co.?), Calif.

MEXICAN, *Liebre.*

In addition to the generic characters, the Blacktailed Jack has:

Size. Total length, about 24 in. (609 mm.); tail, 3¾ in. (95 mm.); hind foot, 5½ in. (130 mm.); ear from notch in dried skin, 4⅞ in. (124 mm.).

Weight of fall specimens taken at Clayton, N. M.: ♂s, 5 lbs. 7 oz.; 5 lbs. 3 oz.; 5 lbs. 12 oz.; 6 lbs. 5 oz.; 6 lbs. ♀s, 5 lbs. 8 oz.; 5 lbs. 12 oz. ♂s taken at Victorville, Calif., March 19, 1922, weighed 5 lbs., and 5 lbs. 12 oz.

Colour. At first sight, this is a very brown Rabbit, with buffy underparts.

A typical male taken at Glenellen, Calif., Jan. 12, 1882, is as follows: All above, wood brown or dark buff, thickly peppered with black hair tips; also dark-flecked by blackish middle part of each hair showing through. All below, clear, deep, warm buff. A small white blaze on forehead (sometimes wanting); a white ring around each eye. Chin, white; cheeks, legs, and flanks, tinged with sienna; breast and belly, buff. Leather apron or breast plate, warm, grayish brown or buff. Tail and rump, browner, but on top of tail is a jet black band which joins the dark gray of the back.

The ears are remarkable. On top, as they lie down, they are like the head—soft buffy, finely peppered with black; behind, pure white, with a large black spot an inch long near the tip. On the outer edge, is a narrow band of white velvet, reaching ¾ of the way to the tip; on the last ¼ it is replaced by a black edging. On the opposite or inner edge, is a whitish fringe of coarse bristles nearly to the tip. Under each ear, on the neck, is a white patch.

These are, indeed, some of the Jackrabbit's tints; but they are varied with a hundred different plays and pretty shades, deepening to sienna and black, or paling to gray and white.

The *nursery fringe* is a very well marked feature. It covers the belly, and is of very long, soft and fluffy hair and down mixed. It is dull whitish, with a brown stain at each knee. It is admirably adapted to cover the young as the mother poises lightly above them.

The male also has this fringe, though it is less developed.

RACES

The following races are recognized:

californicus Gray, the typical form, and darkest of all. T. l., St. Antoine (Monterey Co.?), Calif.

wallawalla Merriam, most like *deserticola*, but upper parts darker, more pinkish iron gray. T. l., Touchet, Walla Walla Co., Wash.

richardsonii Bachman, smaller than *californicus;* head and upper parts of body, light yellowish or grayish buff. T. l., probably near Jolon, Monterey Co., Calif.

bennettii Gray, smaller than true *californicus;* with lighter skull; colour of upper parts paler, more grayish, buffy brown. T. l., San Diego, Calif.

deserticola Mearns, slightly smaller than *californicus;* colours, very pale. T. l., Colorado Desert, Imperial Co., Calif.

eremicus Allen, size of *texianus;* in colour, much paler than *californicus;* darker and warmer than *texianus*. T. l., Fairbank, Cochise Co., Ariz.

texianus Waterhouse, a large, light-coloured form, paler than *eremicus;* little, if any, buff on sides. T. l., probably western Texas.

melanotis Mearns, a richly coloured, buffy race; yet much paler and grayer than *californicus;* underparts, white. T. l., Independence, Montgomery Co., Kan.

merriami Mearns, a large, dark brownish race, with a black nape. T. l., Fort Clark, Kinney Co., Tex.

asellus Miller, like *merriami*, but much larger, and with grayer ears. T. l., San Luis Potosi, Mex.

festinus Nelson, above, dull brownish, like *eremicus*, but darker; ears, longest, except *martirensis;* underparts, white. T. l., Irolo, Hidalgo, Mex.

martirensis Stowell, size of *californicus*, with much larger ears; upper parts, iron gray; underparts, deep pinkish buff. T. l., San Pedro Martir Mts., Lower Calif.

magdalenae Nelson, upper parts, buffy brown like *xanti*, but lightly washed with black; in general, paler; ears shorter, and whiter behind. T. l., Magdalena Id., Lower Calif.

xanti Thomas, back and sides, pinkish buffy brown; somewhat like *bennettii;* head and ears, grayer than in *martirensis;* underparts buff. T. l., Santa Anita, Lower Calif.

insularis Bryant, above, glossy black, grizzled on sides; underparts, cinnamon; size of *californicus*, with shorter ears. T. l., Espiritu Santo Id., Gulf of Calif.

This last, *insularis* or the Black Jackrabbit, deserves more than mere mention. It inhabits the small island of Espiritu Santo, which is about 15 miles long, and but 4 miles from the mainland where dwells the pale desert-coloured *xanti*, which is its nearest relative. And yet, *insularis* is a black Jackrabbit—everywhere dark, and on its upper parts, glossy black. This extraordinary product of environment and isolation is fully described in Nelson's monograph, pp. 36, 37, 156, 157, and 158.

Range and Haunts

Map XIX (p. 739) shows that the range of the Black-tailed Jackrabbit and its near kin is from about longitude 95° W. to the Pacific coast, and from about latitude 43° to the Tropics; overlapped in the north by the Prairie-hare, and in the south, by the Antelope-jack.

Everywhere, fixedly, and all the time, the Jackrabbit is a creature of the open plains. Where there are plains in its region, there are Jackrabbits; and if there be a stretch of forest surrounded by Jackrabbit country, we may rest assured that the Jacks will not enter the shade of the timber.

In northern California and Oregon, the tint that stands for "Jack-rabbit" seems to reach into the big-timbered country; but, as a matter of fact, in that region, the Jack is found only in such parts as are open and clear. The species eschews the big woods, as it does open water, swamps or rugged mountains. A thing of speed, it must live where its speed can always be put forth in an open, straight-away race.

And yet nowhere on bare, flat earth or sand is it found; but ever on the plains, with scattering sage, mesquite, greasewood or cactus. It is, above all things, the child of the sage-bush—cloaked with a sage-gray cloak, helpless

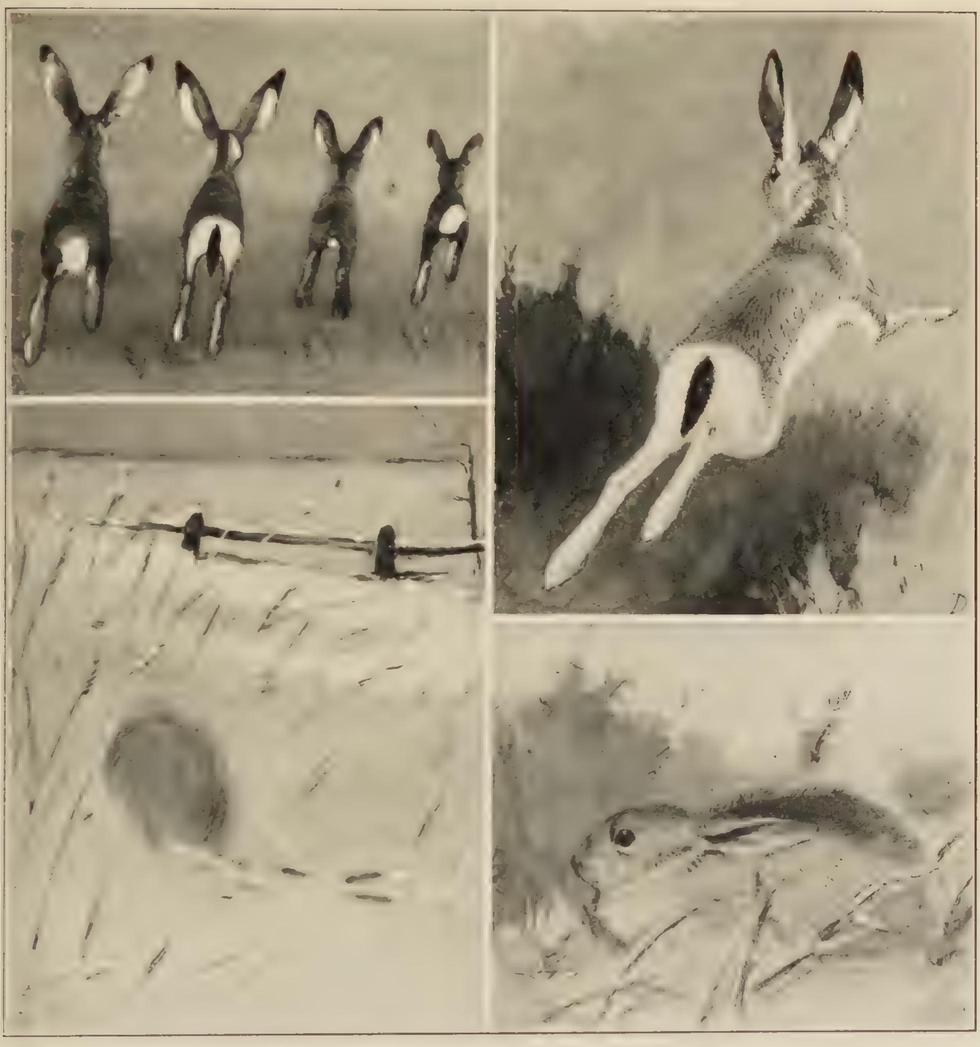


PLATE C.—RABBIT STUDIES

A. The Four Styles,—Whitetailed Jack, Blacktailed Jack, Snowshoe, and Cottontail
B. Form of Kansas Jackrabbit
C. Blacktailed Jack crouching, now wholly protectively coloured
D. The same, bounding away, now directively coloured

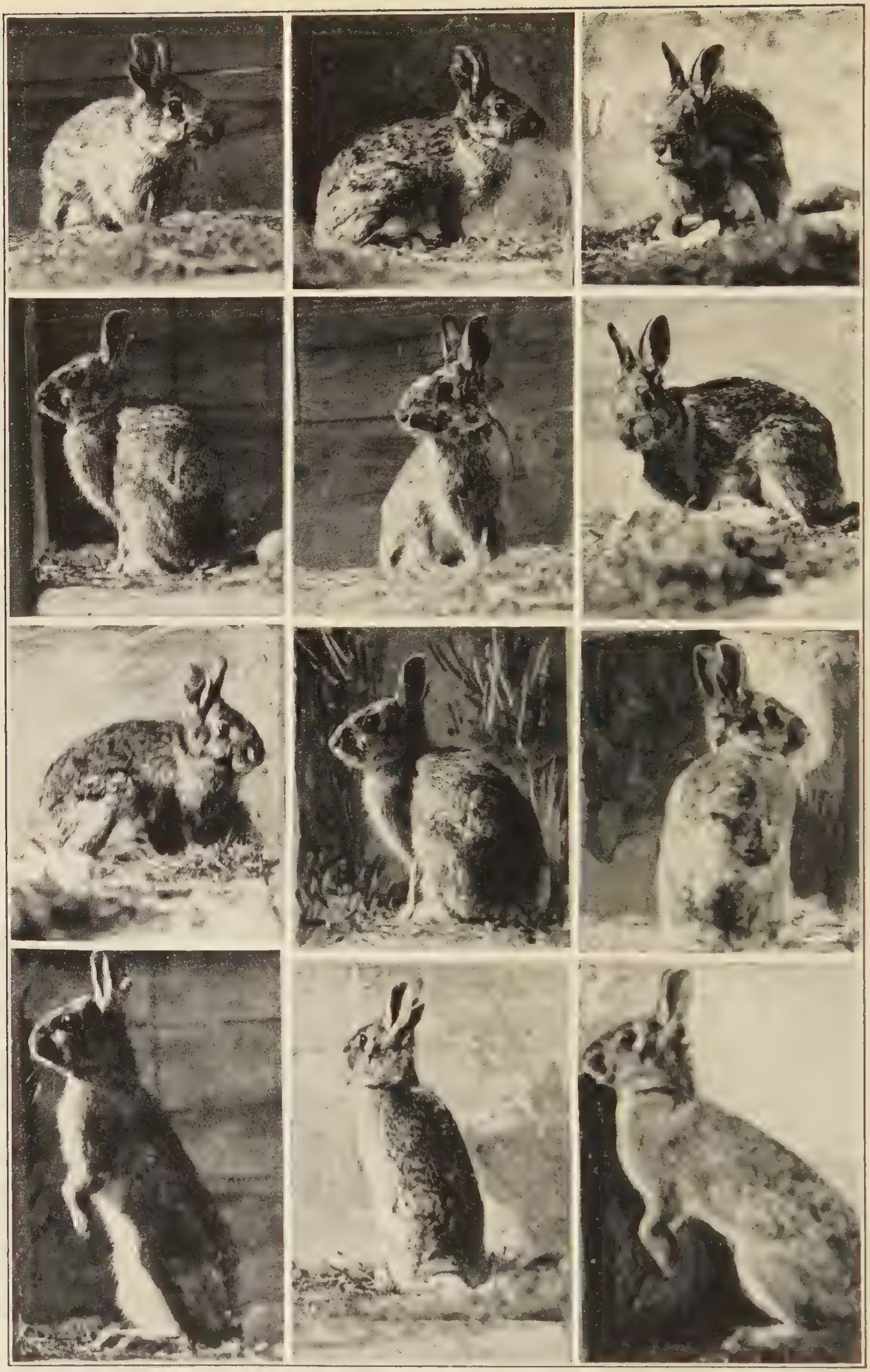
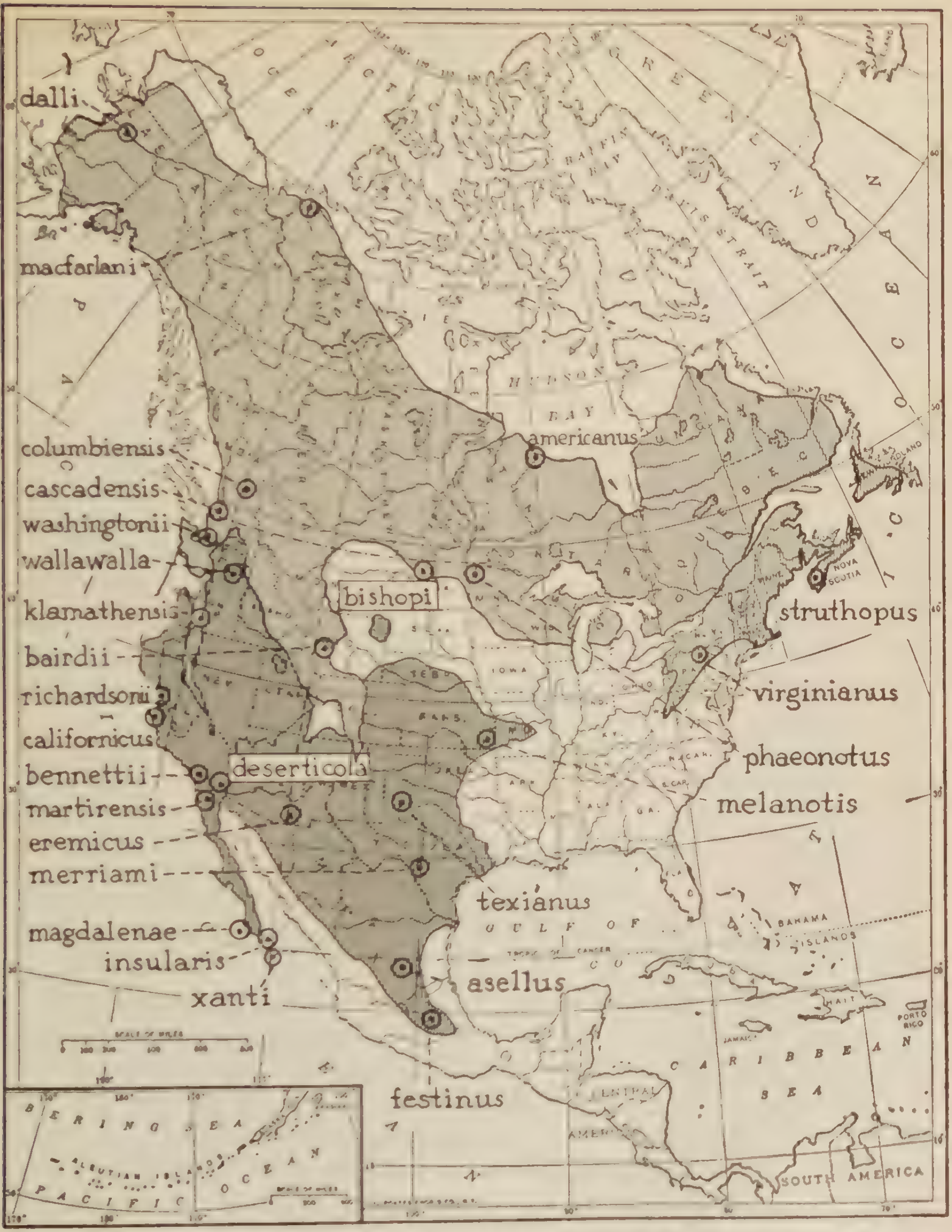


PLATE CIII.—COTTONTAIL STUDIES

By E. T. Seton

Twelve Successive Shots in a Photographic Cage



MAP XIX.—RANGE OF THE SNOWSHOE RABBIT AND OF THE BLACKTAILED JACK

By E. T. Seton, with assistance of the Biological Survey, 1927

against air attack out on the bare plains, abounding exactly where the mothering sage abounds.

HOME RANGE

How big is the home range of the individual? On this, I secured some evidence years ago, by following patiently for many hours through the snow, the track of a fine, big Kansas Jack that was known in the vicinity of Newton, Kan. A square mile roughly represents the area out of which he would not willingly go. This conclusion is sustained by many other observations, as well as by analogy.

THE MATING OF LOTHARIO

No conclusive evidence is at hand on the mating of the Jackrabbit. What little is recorded, suggests that the Jack does not pair; and since promiscuity and polyandry are rare, the established way of the big Jack-hares is probably polygamy. Nevertheless, it is tandem rather than four-in-hand-polygamy, as far as known. My notes made in California have some bearing. They are as follows:

Victorville, March 24, 1922. The Jackrabbits are in full rut just now. The testes of one measured were $2\frac{1}{2}$ inches long, by $\frac{7}{8}$ wide each, and yet were easily pushed back into the abdomen.

This morning, A. M. Byron saw 12 or 15 together in one group, evidently a mating assembly for picking their partners.

On March 18, 1923, at the same place, I found 12 Jacks in pairs—6 pairs clear-cut.

The habits of the European Hare afford corroborative evidence of the above conclusion. Millais says: "Like Rabbits, Hares never truly pair, although pairs may be constantly seen together. A strong buck consorts with a doe for a time, and then leaves her to look for another mate. The bucks fight savagely at times, and can deliver severe blows with their hind legs. They also drum on each other with their fore feet, and sometimes bite. Mr. Drane says, 'I once saw 2 Hares manœuvring, when one jumped over the other, so striking it with its hind feet as to disable it. The striking Hare instantly turned around, sat up, and drummed on its antagonist's body with its fore feet. During the battle, there was no sound but that of the blows. My curiosity induced me to intervene. I picked up the vanquished Hare—it was dead.'"[1]

---

[1] Mamm. Gt. Br. & Ire., III, p. 12.

In my home park, I kept Kansas Jackrabbits for a number of years; and twice at least, saw 2 males fighting in this very way—up on the hind legs, boxing with front feet, and each seeking a chance to leap over the other, and treat him to a "savate" from the powerful hind feet. During the fight, one of them kept up a loud "*qua, qua, qua,*" in a deep, hoarse tone. I do not know whether it was a war cry or a plea for mercy. But nothing happened; no one was killed.

Even in Kansas, I found this Jackrabbit mating as early as Feb. 10th. February and early March may be considered the mating season.

THE NEST THAT HAS NEVER BEEN SEEN

In all the millions—yes, billions of times—on the million-mile range that Jackrabbits in the breeding season have been seen, hunted and shot, with their young ones running or unborn, never once, so far as the record goes, has anyone had the luck to find a Jackrabbit's nest with young in it.

This brings up the question: Does it make a nest at all? The European Hare apparently does not; and I am compelled to believe that our Jackrabbit also makes no nest. It hides its young in a thicket till they are able to run; hides them, not in a spot, but in a locality; and usually but one in each place. The time of hiding is probably only 3 or 4 days.

In the management of the young, we must again refer back to the European Hare as analogy, since we have no definite records of our own. Millais says:

"Soon after the production of her young, the Hare moves her family about, and will place the various individuals in different forms, visiting each at night at different times. It may be that this habit of scattering her progeny in ones and twos, has led to the belief that she usually possesses only 1 or 2 young ones. The Rev. E. A. Woodruffe-Peacock says: 'This regular dispersal of their young into suckling forms soon after birth, is performed at night, and very rarely witnessed. I have never seen it, but was informed that they are carried as a Cat does her kittens!' . . . The mother in every instance took her progeny one by one, and deposited them in separate places in the paddock, subsequently visiting each in turn to suckle it. On the whole, it must be concluded that the Hare is far more prolific than it is supposed to be."[2]

THE MULTIPLICAND

The young vary in number from 1 to 6—never more, and even 6 is rare. The average number is 3, but 4 is common; nevertheless, these figures rest wholly on prenatal counting. On March 8, 1922, at Victorville, Calif., I received a female Jackrabbit, killed by a motor car. She contained 5 young, fully furred and ready for birth. This is the largest number I, personally, have known.

---

[2] Mamm. Gt. Br. & Ire., III, p. 13.

In the South, they are born at any time from early February to late September; that is, every month in the year except October, November, and December. In the northern part of their range, this breeding period is shortened at each end by a month or more.

The fact that young are born every month but three, does not prove that each mother has half a dozen broods per annum. It is likely that each has one, or at most two broods a year, as will be shown; but of this we have no positive evidence at all. There does not seem to be anywhere else in the world, an animal so abundant, conspicuous, and familiar, concerning which so little is known.

In the spring of 1926, I imported half a dozen Jackrabbits from Kansas. On March 27th, the day after arrival, one of them produced 4 young, fully furred and well developed—eyes open—but dead. They weighed respectively $2\frac{5}{16}$ oz., $2\frac{1}{4}$ oz., $1\frac{14}{16}$ oz., $2\frac{1}{4}$ oz. Sexes not ascertainable. Their coats showed exactly adult pattern; 3 had white blazes on the forehead.

How They Grow

The only observations at hand on the development of the young Jackrabbit, are those by Mary C. Dickerson. They are so complete and important, that I cite them nearly in full.

She was then attached to Leland Stanford University, Calif. Her observations appeared in the *Natural History Magazine* of the American Museum, as follows:

Feb. 25th. "I was at my desk in the University laboratory, my back to the window with its view of mountains and foothills. Suddenly there was shouting, and a rush of feet on the campus outside. Three labourers were chasing and stoning a Jackrabbit. Soon they had it cornered in an angle of the buildings, and were about to use a club. It was the work of but an instant to reach the door, and by a bribe, change the intention of the man with the club. So the Rabbit was caught unhurt (not without the expense of numerous long scratches on the arms and hands of the captor), and was soon in a Rabbit house improvised from a packing box. She did not give up her freedom without further struggle; but between the periods of bewildering activity and thunder of hind feet on the wood of the box, she looked out from her temporary prison with large, gentle eyes.

"The next morning (Feb. 26), on entering the laboratory, I chanced to observe a small, brown oval patch in a corner of the room. Bending down over it, I saw two large, luminous eyes gazing mildly at me. It was a baby Jackrabbit, so small that it could be held, I found, and partly covered in one hand. Diligent search of the room disclosed one other baby Rabbit in the farthest corner under the radiator—a family of two. Both together could be held securely in one palm, and they showed little fear and no desire to leave the spot.

"The California Jackrabbit (*Lepus californicus* Gray) is born in an unusually advanced condition. The young Rabbit is covered with fur, his white teeth are cut, and his eyes are wide open. His coat is brown, with accents of yellow and black, much richer in colouring than the grayish fur of his mother; and he is labelled a very young baby Jackrabbit by a light gray area which surrounds his mouth and his brown wiggling nose—like a round bib tucked above his chin instead of below.

"On comparison, he scarcely seems the son of his mother. His ears are not half the length of his head, whereas hers exceed the head in length by 2 inches. Also his muzzle is short and broad instead of long and pointed like hers—in fact, his face is ludicrously flat below the eyes, as though he were really as soft and plastic as he looks, and had received a gentle but convincing blow on the nose. And thirdly, his short, stocky legs would certainly classify him as the offspring of some other Rabbit than a Jack.

"But these are all items of his immaturity. By the 10th day, the ears and legs begin to lengthen out of proportion to the increase in growth elsewhere, and his muzzle also begins to lengthen and narrow. The changes in the shape of the muzzle and in the length of the legs are gradual; but the growth of the ears from this time on, is astonishingly rapid. At the 15th day, they equal the head in length; soon they outstrip it, until at the close of the 4th week, they are 4 inches long; and at the end of the 5th week, measure $4\frac{1}{2}$ inches, whereas the head is then only $2\frac{3}{4}$ inches in length. It is amusing to see Baby Jack take advantage of this increased length of his ears to haul them down and wash them conveniently in his mouth—he has the instinct to wash his face from the first morning of his life.

[Note that in the young Jackrabbit a month old, the ears are proportionately longer than in the adults. In the young Cottontail, they are very much shorter.]

"During the first days, Jackrabbits have a generalized sense of fear, squatting with lowered ears at any sound or movement; also they have a bravado not possessed later, turning and jumping at the enemy in pugilistic fashion, while expostulating in a harsh, low-pitched voice. Later, their fear becomes very definite and vivid, yielding not a jot to months of care and captivity.

"One of the most conspicuous signs of a Jackrabbit's babyhood lies in his inability to gauge perpendicular distances. For the first few days, his instinct keeps him pretty closely to the ground nest; otherwise he would try to walk downhill as though it were level, or would unwittingly walk off any rock or hillock, and so might get many a tumble. It is not until the third day that he begins to be cognizant of the ups and downs of his world. His development is rapid, however, and 24 hours later he stops and studies every situation.

"On the 4th day, he begins digging; and from this time till he is 5 weeks old, spends much time in this employment. Serious-eyed and absorbed, he works very hard—like all young animals he is 'dead in earnest.'

[It is exceedingly interesting to note that the young Jackrabbits go through a digging stage, suggesting that such was the way of their remote ancestors. But they entirely give it up later and conform to the custom of the race: no adult California Jackrabbit has been known to dig or enter a burrow.]

Play Is the Business of Childhood

"Jackrabbits have the play instinct from the first day. In this case observed, play activity increased steadily from the 4th day to a maximum at the close of 2 weeks, then continued, apparently without change, except as influenced by increasing muscular strength. Playing Rabbits are intensely alert. When facing away from each other, suddenly, with what seem simultaneous leaps a foot or more in the air, they are turned about touching noses. They bound away in devious curving and zigzag courses, moving with indescribable lightness, and stopping with startling abruptness. One jumps at the other 'pell-mell'; he, in turn, shoots straight up into the air, dropping to a listening position with long ears held far forward, very Deerlike. Again, they take to following the leader; one jumps over a stone, the other follows: the first leaps a chasm 2 feet wide, the second is at his heels; they crouch in the shadow of a stone, then dash out into the light, capering; then peer out from the shadow again where they remain, momentarily interested in washing each other's faces. Soon they are playing boisterously again, one bounding into air without any preliminary hint of such an intention, the other shaking his head until his long cartilaginous ears snap together. Finally, one of them sees something that stimulates his curiosity. He watches eagerly, his ears straight forward and widely opened. He progresses a little, he drops one ear, he moves slightly to the right, to the left, he stretches slowly forward, investigation written plainly in eyes, ears, and tense muscles. Ah! it's only a shadow after all, and Bunny Jack races away, lowering his tail, so that it is like a little black streak between his flying hind legs.

"The most surprising thing about young Jackrabbits, in the light of the fact that they are so highly developed when born, is their continued dependence on a milk diet as the weeks pass. On March 2d (6th day) they showed the first recognition of the possession of teeth by chewing at the nest material. When 2 weeks old (March 10th), they gained their first interest in grass, sniffing at it with noses a-wiggle, and little red tongues thrust out at right or left, but refusing to eat more than one or two of the grass ribbons. The 3 weeks limit was reached (March 17th), 4 weeks were gone (March 24th), 5 weeks (March 31st), and the situation seemed astounding. Six weeks (April 7th), at last they showed willingness to eat clover and grass. During the 7th week, they were weaned from their improvised 'bottle'—most unwillingly on their part—and with the change in diet, became increasingly wild."[3]

This long period of dependence on their mother is a surprising and interesting fact. It is definite proof that the oft-asserted 3 or 4 broods per annum are an impossibility. For the time of gestation is about 30 days, the raising of the young 40 days at least, rest period before the next heat at least 30 days, a total of 100 days. So that in the South, the Jackrabbits may have 2 broods in the season; but I doubt much whether in Kansas and Colorado, they have more than one.

The problem, however, is further complicated by the possibility suggested in the following observations on the European Hare:

"A curious fact is that the ovaries are capable of superfoetation; on many occasions, unborn young of different ages have been discovered."[4]

The Nursing of the Young

In the total absence of information as to how the mother Jackrabbit cares for her young, I offer some testimony as to the ways of the European Hare, which will at least show us what to look for. The Rev. E. A. Woodruffe-Peacock says: "The guttural pipe of the doe, and the minor key of her young, as she passes from one milking form to another, are well known sounds of the evening and early morning in the country where Hares abound."[5]

Again: "While seeking information on this subject," says Millais, "I received the following note from Sir Richard Graham, who is a great Hare preserver: 'Bell (a very intelligent keeper on the Netherby estate) tells me that the doe Hare has a very peculiar sort of a noise she makes when she has young. It is something between a grunt and a whistle. He says that it is possible to hear the doe quite distinctly at a distance of 300 or even 400 yards. He also says that she runs the scent of her young ones just like a Dog, and she utters the cry as she goes along. She will also sit still and bring the leverets to her side with a similar call.'"[6]

---

[3] Jack-rabbit in Calif., pp. 71-74.

[4] Millais, Mamm. Gt. Br. & Ire., III, p. 12.

[5] Cultivation of the Common Hare, p. 10, quoted in Millais' work, p. 14.

Solitary and Selfish

Jackrabbits may swarm in certain regions, but they are never sociable or gregarious except when mating. No one ever saw a flock of Jackrabbits keeping together, and obeying some common impulse that was binding on their movements. No one ever saw a colony of Jackrabbits—that is a thicket or any other limited area in which a score of mothers had their young assembled for protection. No one ever saw two or more Jackrabbits combining to achieve some common object. Therefore the Jackrabbit is essentially solitary not to say selfish, which amounts to the same thing.

Communication and Voice

Sociable animals have most means of communication; therefore the Jackrabbit should have but few, and these of poor development. Be it noted first, so far as known, the Jackrabbit does not signal like the Cottontail by thumping with his hind feet. His vocal signals are but few, so far as I have seen. Outside of the warwhoop, already described and the loud scream of terror given occasionally when caught, I never heard my Jackrabbits make any sound. Nevertheless, we are here confronted by the handicap of wholly inadequate observation.

So far as I have seen them—and my opportunities have been good—the Jackrabbit and the European Hare are very similar in habits and in gifts; therefore I again incur the risk of using sidelight, by quoting from Millais on the habits of the European Hare, believing that ultimately we shall find these same habits obtain in our Jack.

After noting the grunting and hissing of Hares in combat, the Rev. E. A. Woodruffe-Peacock says: "Hares also make other sounds—love calls and a warning call. The latter is like the peculiar stamping with their hind feet of Rabbits, in its result. It is undoubtedly produced by the grinding together of their teeth. This sound always puts every Hare within hearing on the alert for danger. It may be distinctly heard in a well-stocked country by placing the ear against a dry gatepost, and then touching the gate so as to make the latch rattle. The sound is then taken up and passed on from Hare to Hare over a wide area."[7]

---

[6] Mamm. Gt. Br. & Ire., III, p. 15.

Similarly in the same work (p. 15): "Messrs. Mann, of Aigle Gill, possessed a female Hare which on summer nights would call softly to a wild jack Hare which came to visit her. They used to call to each other in low and plaintive tones."[8]

As already noted, the mother Hare has a peculiar call with which she can assemble her young.

"Captain Brander-Dunbar likens the call of the doe Hare to the bleating of a lamb. Mr. [Robert] Drane, of Cardiff, writing on the voice of the Hare, says:[9] 'Both sounds (of fear) are uttered with wide open mouth, and resemble the repeated word "*arnt*" or, if you will, "*aunt*." I believe that this is the only open-mouthed voice of the Hare. But it emits other sounds with a variety of meanings, with closed mouth, which resemble our contraction "*don't*," "*wont*," and "*ont*." I can always make my Hares say "*don't*" as we say "*hump*," without opening our lips, when we mean to indicate incredulity or contempt. This is done by a quick movement of the hand, as if to seize the creature suddenly. If the same movement is made slowly, no sound is emitted. This exclamation is a very clear "*don't*," but not loud; it is, indeed, often only just audible. That is when one does it often, or repeatedly at one time to a Hare which is so perfectly tame that it knows no harm is threatened!' "[10]

While these observations do not prove that our Jackrabbits do the same thing, the fact that the two species are near kin makes it probable. At any rate, we have not at present any evidence to the contrary.

STRANGE INCIDENTS

This last section reminds us that the Hare is the emblem of timidity, the visible embodiment of it, and the Latin name of the European species is *Lepus timidus*. The following incident from the pen of W. B. N. of Tucson, Ariz., concerning the present species, is an illustration in point. It shows the taming power of fear.

"The other day, when driving in the Cattle, the herd evidently trapped and surrounded a Jackrabbit. I was driving them along, from behind, and saw it come crawling out, ears flat back, and evidently scared to death. If I had been on foot, I believe I could have quite easily picked it up by the ears. I first saw it picking its way along, dodging their hoofs. It was crawling so flat to the ground that I did not recognize it at first as a Jackrabbit. After it had successfully emerged, and the last cows were well by it, it slowly recovered from its daze, lifted up its ears, and when we were 50 feet beyond, it hopped off in a natural manner."[11]

---

[7] Cultivation of the Common Hare, p. 10, quoted in Millais' work, p. 14.

[8] H. A. MacPherson, The Hare, Longman's Fur, Feather and Fin Series.

[9] London Field, March 25, 1905.

[10] Mamm. Gt. Br. & Ire., III, pp. 15–16.

A Rigid Vegetarian

Like the rest of its family, the Jackrabbit seems to eat everything that is green, or grown by a green tree or herb. Every form of plant life in its region seems to provide it with food. And when the thrifty farmer came along, and dispossessed the sage and cactus to plant alfalfa and cantaloups, the Jackrabbit said: "Good! These things are much to my taste," and proceeded to commit the unpardonable sin of rabbithood—destroying man's property.

Here is the official indictment that followed:

"In the West and Southwest, Rabbits are destructive to watermelons and cantaloups, eating the young plants as well as the fruit. At Laredo, Tex., H. C. Oberholser, of the Biological Survey, observed that Jackrabbits had ruined an entire field of cantaloups when the plants were about 6 inches high, and had greatly damaged a field of watermelons. At Sequin, Tex., in Nov., 1904, Vernon Bailey found that about 75 per cent. of the watermelons in one field had been destroyed by Jackrabbits, and that cantaloups could not be grown except when protected by rabbit-proof fences."[12]

It is easier, perhaps, to list the things the Jackrabbit will not eat. It avoids fish, flesh, fowl, reptiles, and insects; never was known to cannibalize, or to eat creosote bush; and I never knew one to dig, climb, or swim for its food. It dislikes and avoids lime, sulphur, coal tar, and blood, when these things are used as smears to protect the bark of orchard trees.

The Drink of an Abstainer

The Jackrabbit does not drink. Oh, amazing creature! in view of all that is implied by "apple-jack," "jack-boot draughts," "Jack tar," etc. Dust-dry is his country, and his habit. Like many of the desert creatures, he finds in the juice of his food-plants, a sufficiency of moisture to mix his blood, or dissolve away his toxins.

Dr. S. M. Babcock, in his paper on *Metabolic Water* (see References), shows that carbohydrates, fats and proteins may be chemically converted into 50 to 100 per cent. of their weight in water, by oxidation or molecular change, within the cells of the body.

---

[11] Forest & Stream, Jan., 1920, p. 27.

[12] Rabbit as a Farm and Orchard Pest, by D. E. Lantz, Yearbook, Dept. Agr., 1907, p. 332.

PROTECTIVE COLOURING

The Common Jackrabbit, when squatting under a sage-bush, is simply a sage-gray lump without distinctive colour or form. His colour, in particular, is wholly protective; and it is usually accident, rather than sharpness of vision, which betrays the creature as he squats. But the moment he springs, he is wholly changed. It is difficult to realize that this is the same animal. He bounds away with erect ears, showing the black and white markings on their back and under-side. The dark nape is exposed, the tail is carried straight down, showing its black upper part surrounded by a region of snowy white; its legs and belly show clear white. Everything that sees him, is plainly notified that *this is a Jackrabbit*. The Coyote, the Fox, the Wolf, the Badger, realize that it is useless to follow; the Cottontail, the Jumping Rat, the Fawn, the Prairie-dog, that it is needless to flee; the young Jackrabbit, that this is its near relative; and the next Jackrabbit, that this may be its mate. And thus, though incidentally useful to other species at times, the sum total of all this clear labelling is vastly serviceable to the Jack himself, and saves him much pains to escape from real or imaginary dangers.

As soon as he squats again, all the directive marks disappear, and the protective gray alone is seen. In summary, when *sitting*, the Jackrabbit is *protectively* coloured; when *running, directively*.[13]

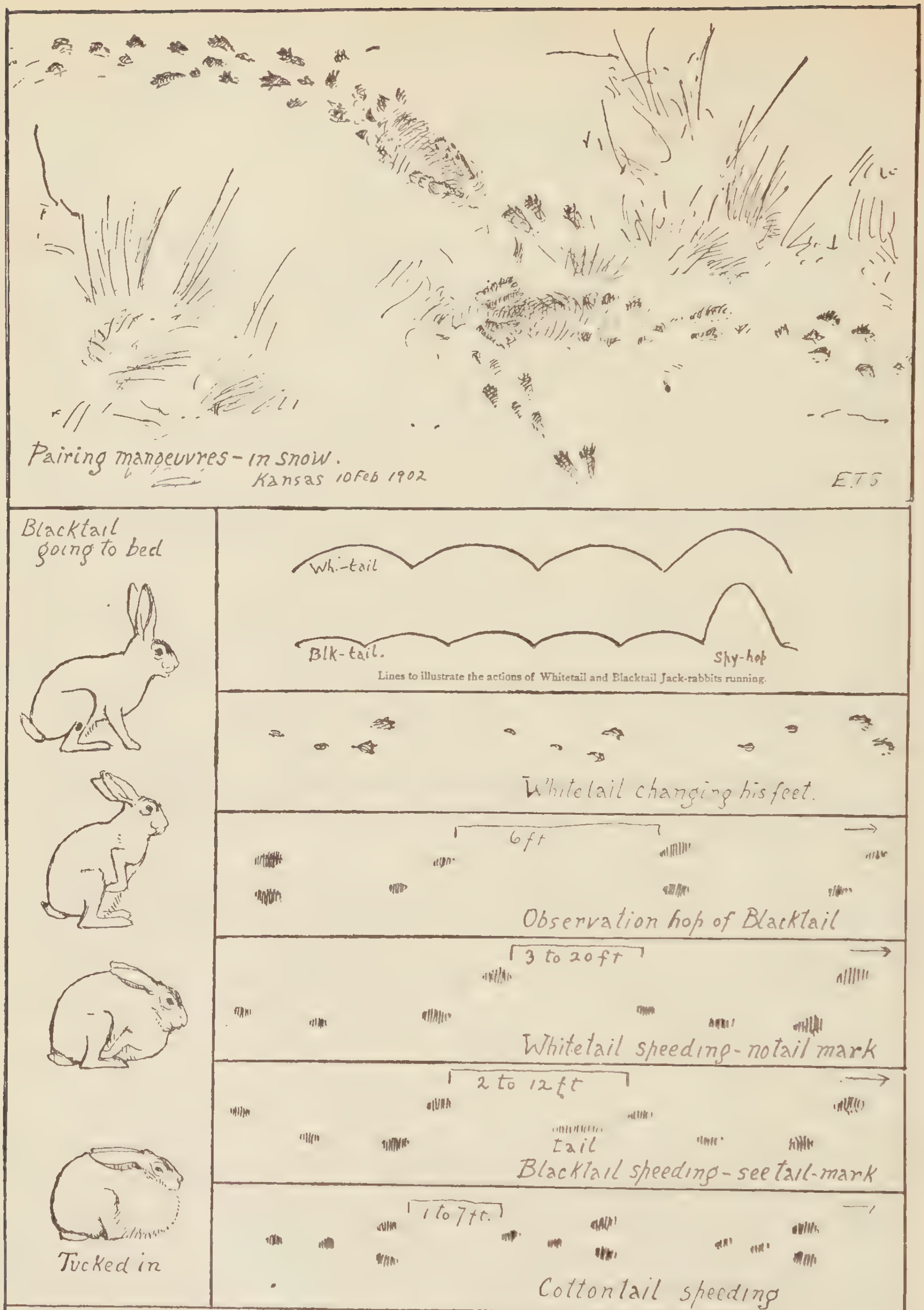
On my grounds where I keep various wild things, I startled a Kansas Jackrabbit, Dec. 20, 1926. He ran across the frozen lake; and, as he bounded zig-zag away, he flung his saddle blanket from side to side, exactly in the fashion attributed to the Antelope-jack. This was the first time I had seen or heard of it in this species, but have noted it several times since. Whether a protective or directive manœuvre, I do not know.

THE TRACK—ITS STORY

Plate XCVIII (p. 750) shows the general features of the Jackrabbit track. Compared with that of the Cottontail, the Jack is larger, leaves a tail mark, the hind feet are not paired in speeding, the hops are longer. In the Cottontail, the hind feet are always paired, sometimes the front also. The Cottontail rarely clears over 6 or 7 feet, the Jackrabbit commonly covers 10 or 12. The longest I ever measured was in Kansas—15 feet clear.

---

[13] See Directive Colouration, by E. T. S., The Auk, Oct., 1897, p. 395.


Pairing manoeuvres - in snow.
Kansas 10 Feb 1902
E.T.S.
Blacktail going to bed
Tucked in
Wh.-tail
Blk-tail.
Shy-hop
Whitetail changing his feet.
6 ft
Observation hop of Blacktail
3 to 20 ft
Whitetail speeding - no tail mark
2 to 12 ft
tail
Blacktail speeding - see tail-mark
1 to 7 ft.
Cottontail speeding

Lines to illustrate the actions of Whitetail and Blacktail Jack-rabbits running.

Plate XCVIII. Tracks etc. of Rabbits →

E.T.S.

ENEMIES—ALL THE WORLD

Outside of the implacable, remorseless, and unreasonable arch-enemy of every living wild thing, the Jackrabbit has a long array supplied by nature on its most ancient range.

Among the birds of prey which "feed on Jackrabbits, are the barn-owl (*Strix pratincola*), Audubon's caracara (*Polyborus cheriway*), prairie-falcon (*Falco mexicanus*), and Western red-tailed hawk; but remains of the Texan Rabbit have been found in the stomach of the red-tail in only 3 cases among a large number examined. The Western horned owl (*Bubo virginianus subarcticus*) and the golden eagle (*Aquila chrysaetos*) should also be mentioned. The marsh-hawk (*Circus hudsonius*) occasionally attacks Rabbits; and Mr. J. Alden Loring shot one at Vernox, Tex., while in the act of killing a young Jackrabbit which weighed a pound and a half."[14]

Chief among his four-footed enemies are the Coyote, Gray-wolf, Desert Fox, Gray-fox, and Bobcat. Skunks, Weasels, and Badgers may occasionally destroy the young, but seldom, if ever, the full-grown Hares. The Badger, an indefatigable hunter of the Groundsquirrel and the Prairie-dog, is too slow of foot to overtake the Jackrabbit in a fair race; and is unable to corner him in a hole, as he can a burrowing animal.

The Coyote is a most persistent rabbit-killer, probably the worst of all quadrupeds; and does far more destruction in this way than is generally known. The following notes show how this is effected:

"In trapping on the greasewood flats about Kelton, in northern Utah," says Bailey, "during the latter part of Oct., 1888, I noticed in many places that Jackrabbits (*Lepus texianus*) had been killed and eaten by some animal. The feet, bits of skin, and fur were usually all that remained; but I immediately attributed this destruction to Coyotes; and later on, was able to verify the conclusion by finding remains of Rabbits surrounded by fresh Coyote tracks. In a walk of a mile it was common to see where a dozen had been eaten; I could even see where the Coyotes had run and caught the Rabbits. The number killed was surprising, although both Rabbits and Coyotes were numerous. As I walked through the brush, Jackrabbits would jump up and run every few minutes, and Coyotes were frequently seen. In this particular spot, the numerous bunches of greasewood (*Sarcobatus*) scattered over the smooth valley bottom gave the Coyotes a great advantage, enabling them to approach close to the Rabbits and probably catch them before they got fairly started."[15]

---

[14] Palmer, Jackrabbits of U. S., p. 44.

[15] Jackrabbits of U. S., p. 45.

The bull-snake and the rattler must not be forgotten as enemies of the Jackrabbit. They continually prey on him, and are doubtless responsible for the disappearance of many of the young.

INSECTS AND OTHER PARASITES

But there are other enemies—smaller, yet far more deadly, than the fiercest creature Jack ever meets in fur and feathers. These are the host of insect and other parasites. Prof. E. Ralph De Ong, of the University of California, has given us a summary of the insect parasites found on Brush and Cottontail Rabbits.[16] The list includes wood-ticks, fleas, ear-mites, bot-flies, tape-worms, and a sporozoa. It is nearly certain that every one of these is also parasitic on the Jackrabbit; and that, in addition to its menace as a drain and irritant, is also provocative of a number of diseases, such as tularæmia which may be communicated to humans through handling the uncooked flesh.

In summarizing these, Dr. T. S. Palmer says:

"Jackrabbits are subject to epidemics, which occasionally reduce their numbers very materially. These outbreaks are more or less local, but are reported every few years. According to Mr. George Watkins, Rabbits were found in large numbers in Ash Meadows, Nevada, previous to 1891; but in the spring of that year they were very rare. He attributed the decrease to the prevalence of an epidemic, which had been so severe as to render these animals almost extinct. In northeastern California, Mr. A. C. Lowell of Fort Bidwell, Modoc County, mentions seeing many dead Rabbits in the autumn of 1893.

"A similar occurrence is reported by Mr. F. Stephens, near Beckworth Pass, Plumas Co. Speaking of a trip through northeastern California in August, 1894, he says: 'The epidemic among Hares was widespread through all the region I passed over north of Beckworth Pass, being perhaps most noticeable in the Madeline Plain on the South Fork of the Pitt River, and near the Nevada line south of Surprise Valley. In all these places I saw daily dozens of carcasses near the road. The only cause of death that I could see was the abundant warbles (*Cuterebra*) present in nearly all. It would seem, though, that these could only operate by lowering the state of health generally, and that some contagious disease was present.'

"Dr. J. A. Allen speaks of an outbreak that occurred in the vicinity of Great Salt Lake in 1870–1, destroying large numbers of *Lepus texianus* and *L. campestris*;[17] and Prof. Marcus E. Jones states that another occurred in

---

[16] Cal. F. & G., July, 1919, pp. 142–43.

[17] Monographs of American Rodentia, 1877, p. 372.

Utah in 1885 or 1886. A similar instance of the destruction of the Prairie Hare (*Lepus campestris*) has been mentioned by Mr. Gibbs and Dr. Cooper, which occurred in Washington north of the Columbia River about 1853.[18]

"Mr. Clark P. Streator, while at Pasco, Wash., near the mouth of Snake River, learned that another epidemic had occurred among the Rabbits in the vicinity during the summer of 1890. Maj. Chas. Bendire states that the inhabitants of the Payette Valley, Idaho, claim that epidemics occur among Jackrabbits in that region every 5 or 6 years."[19] Dr. Harris Garcelon, of Victorville, Calif., tells me that hæmorrhagic septicæmia is the epidemic that periodically wipes out the Jackrabbits on the Mohave Desert.

His Speed—His Way of Life

To run like a Jackrabbit is said to be the climax of speed; and it was a common saying among my cowboy friends, that you have a good Horse if you can follow a Jackrabbit so fast and so far that you can make him lay down his ears.

In the Antelope Life, I have given a scale of speed, founded on many observations. In this, the accredited rates are: Blooded Racehorse, best speed for a mile is at the rate of 34 miles an hour; Greyhound, 30 miles; Jackrabbit, 28 miles; Coyote, 24 miles. These, I know, are far below the popular estimates, but I have studied the matter for years, and am not disposed to change them. The Jackrabbit seems a wonderful speeder, but I have seen scores of Jackrabbits taken by Greyhounds; and know that, in a straight race, the Greyhounds can take the Rabbits within a few hundred yards. The one ruse that serves the Hare is rapid doubling. This will save him only if he can get out of sight. But usually, two Grey-hounds are run at once. The Hare, dodging from one, falls into the jaws of the other; and in the race when he has 50 yards' start, he is commonly done to death within 300 yards.

At Ash Fork, Ariz., March 6, 1905, I saw a Jackrabbit loping along easily. He made 20 hops in 5½ seconds by stop-watch—that is, at the rate of 218 hops to the minute, and about 10 feet to each hop, making 720 yards per minute. His observation hops were very high—about 4 feet, I should say—and took three times as much time as the low bounds; that is, he could make 3 low bounds while he was taking 1 spy hop.

From my window to-day (Feb. 14, 1927), at a distance of 12 feet, I watched a Jackrabbit go to bed. I had had no idea of what a ceremony it is;

---

[18] Monographs of American Rodentia, 1877, p. 372.

[19] Jackrabbits of U. S., pp. 45–46.

it reminded me of "*le petit coucher du roi*," during the time of Louis XIV. Having selected a smooth, sheltered spot in the snow on the ice, the Jackrabbit posed himself with elaborate precision—this way and that—till the wind was right behind. Then he pulled in his neck, pushed forward his hind feet, raised up, and fluffed the nursery fringe till it spread outside his hind feet; then he swung backwards till his weight was entirely on his hinder feet and his padded tail was the cushion on which he sat. Next, he drew back his head, and puffed out his breast, so his fur collar partly wrapped his cheeks and ears. Then he bent his furry hands, and thrust them into his pockets—that is, the abundant wool fringe. His wrists were bent like knees upon this long fringe,—a carpet under them. In fact, he did pretty much as King Louis did on a rug for his "little prayer." Now, Jack wobbled his nose a little, flattened his ears on his back, sank his head deeper into his coat collar—and was at rest; maybe asleep. But I don't know. His eyes were open. It is said they sleep that way. *Quien sabe ?* (See Plate XCVIII, p. 750.)

In the bygone days of the glorious West, when I cow-punched on the plains of New Mexico, the Jackrabbit was the common and happy little incident of a morning's ride. A dozen times a day, he would spring away from near the broncho's feet, and go bounding off in characteristic fashion—a few long, low springs, in each of which he covered 10 to 15 feet, then a high hop—a spy hop—a Kangaroo jump—up in the air to look around, just as did the Springbok of Africa. Away he would go, and many a day I yielded to the temptation to try my pony on him. A blooded racer, of course, could outrun the Jack, but a cow-pony was soon left behind. Over the nearest prairie swell would Long-ears go; and time and again, I followed, but saw him no more. His invariable plan seemed to be to cross the ridge, then squat again in some friendly cover; especially if he were disturbed when the sun was high, for he loves not the noon glare. In the evening, he is much more likely to keep on going; for, like all Rabbits, he is crepuscular—even nocturnal.

NUMBERS IN EARLY DAYS

The dozen that I saw in a day's ride were, obviously, only those in the immediate track. Undoubtedly, there were many more that saw me, but did not leave their forms, or "beds," as we called them. This was considered Jackrabbit country; and I should say that 15 or 20 to the square mile was the largest probable number of Jackrabbits in the region. They seemed far less numerous than the Antelope in those days.

A hundred years ago so far as I can learn, the rate noted in New Mexico prevailed throughout most of the Jackrabbit country. This covered, in round numbers, 1,000,000 square miles; that is, there may have been 20,000,000 or 30,000,000 Jackrabbits in those balanced and primitive days.

The Rabbit Menace

Then came a change, a sudden and appalling increase in the Jackrabbit population—a change which is variously explained.

One group maintains that the persistent warfare on Coyotes, Wolves, Foxes, hawks, owls, snakes, and other enemies of the Jackrabbit has so reduced these natural checks that the vast fecundity of the Rabbits has had its logical result.

Another group believes that the extraordinary multiplication is due to the unusual food supply afforded by the new and general farm crops; for sagebrush may be sufficient for one Rabbit to the acre, whereas alfalfa will support 20.

Still another group holds that many complex and imperfectly understood ecological factors are involved, of which two of the most important are the food supply and epizoötic diseases. At all times, the numbers of Rabbits have been enormously fluctuant, and while predatory animals and birds obviously reduce them to some extent, the predatory species alone are ineffective in controlling numbers when other conditions favour an increase. The Biological Survey experts hold to this view.

It is well to remember, however, that the predaceous animals are part of the chain that makes possible the deadly epizoötics. Such animals are essential as hosts and carriers of many diseases. So that the case is increasingly complex.

But the big fact remains that the Jackrabbits became multiplied to such legions that they threatened the new agriculture with destruction. In various parts of the West, plagues of Rabbits appeared; but it was in California that the damage was greatest. Here, in the San Joaquin Valley, the new-cult farmers found themselves facing absolute ruin at the instance of the myriad Jack-folk; and, in desperate self-defence, devised various new modes of destruction to meet the new peril. Among these were: the all-day shoot by the whole community, wholesale poisoning, and drives.

The Devouring Hosts

Some idea of the appalling multiplication of the all-destroying Jacks may be gathered from the following facts:

In the October of 1899, while collecting in the country about Bakersfield, Calif., I counted 20 to 30 Jackrabbits on every acre. Each tussock that

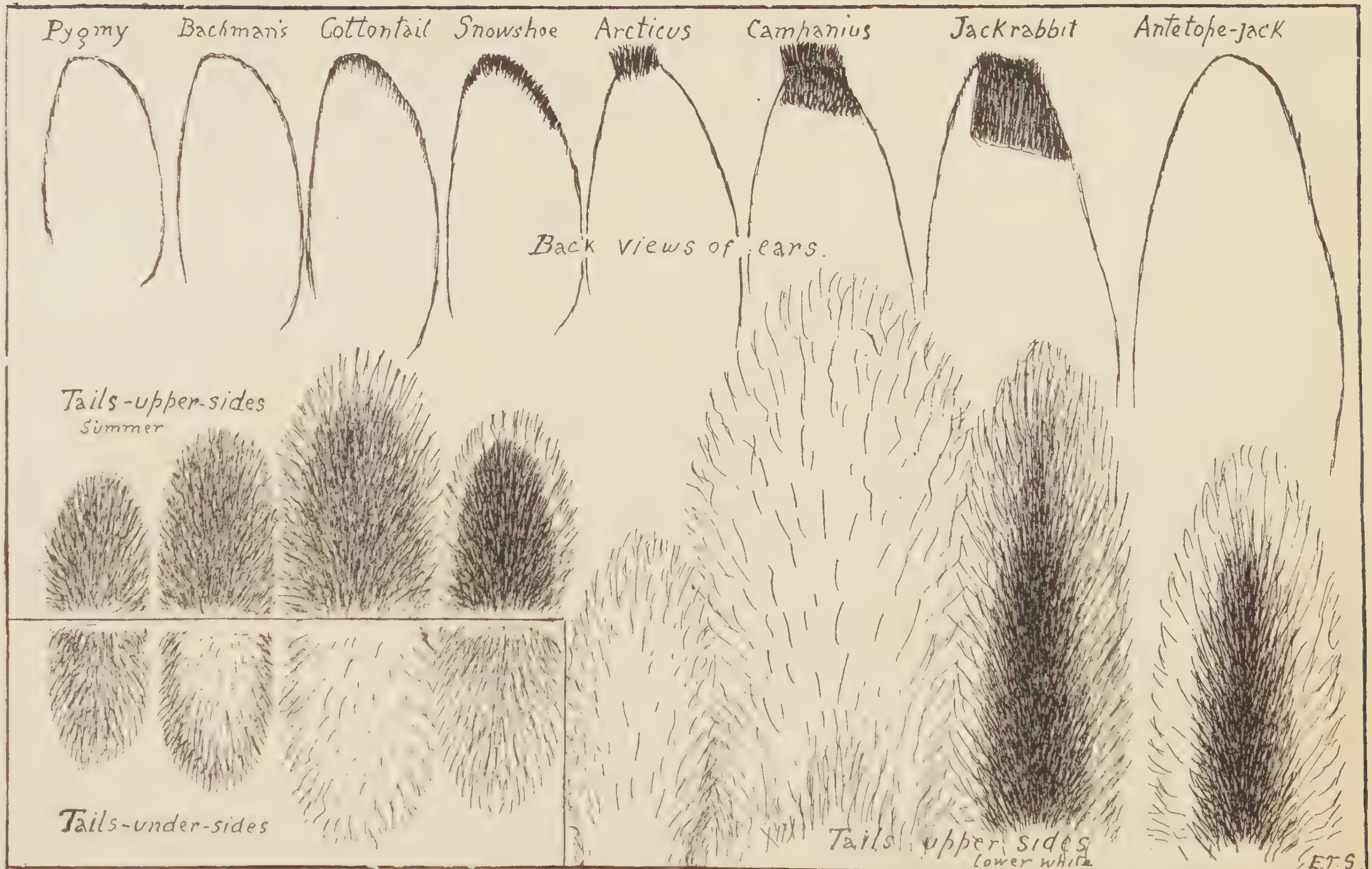


Plate XCIX. Various Rabbits - Ears (backviews) - Tails (upper views - chiefly) All about $\frac{2}{3}$ life size.

I approached or threw a stone at, gave up at least one Bunny—a big, flop-eared Jack.

On July 17, 1906, Charles Payne, of Wichita, Kansas, was at my house and gave many data on Jackrabbits. He was catching them alive for the market, and had had vast experience. He worked with nets that enclose a quarter section of land (160 acres); and says that in Kansas, during a Rabbit year, the Jacks will "pan out" 200 to the 160 acres in favourable localities. Among the sandhills, he had seen 300 to the quarter section; and in other places, they were down to a dozen.

On March 21, 1923, I was on the Mohave Desert, near Victorville, Calif. I took a 20-minute walk around a low knoll, covering perhaps 10 acres. In that time, I saw 12 Jackrabbits. I have every reason to suppose that this fairly represented the population of the region—that is, there may have been 500 to the square mile.

"In Modoc County, northern California," says Palmer, "nearly 25,000 Jackrabbits were said to have been killed in 3 months on a tract of land only 6 by 8 miles in extent; this was during the period when the bounty law was in force. A still more remarkable case has been recorded in the San Joaquin Valley."[20]

Dr. Harris Garcelon, of Victorville, Calif., tells me (March 19, 1919) that on the Mohave Desert, the Jackrabbits are subject to the usual fluctuations. Great Rabbit years were the fall of 1910 and again in 1915. There were so many in 1915 that, during a 7-mile trip, he counted 148 sitting by the roadside; and in one afternoon, standing guard with a club over a hole in the wire fence around a cultivated field, he killed between 250 and 300. These were not driven; it was the ordinary traffic of every day.

Such figures sound high; yet, as noted later, according to Dr. T. S. Palmer, 8,000 Jackrabbits were killed in 9 days on a Bakersfield ranch that was less than a mile square.[21]

THE BIG SHOOTS

The "all-day shoot" of the whole community was early attempted as a solution that also offered a little sporting relish. These were the Western parellels of the Squirrel side-hunts of early days in the woods.

The "one-day's Rabbit shooting" at Lamar, Colo., by 200 guns, Dec. 31, 1894, resulted in the destruction of 5,142.[22]

---

[20] Jackrabbits of U. S., p. 24.

[21] As above, p. 24.

[22] The Squirrel Hunters of Ohio, by Dr. N. E. Jones, 1898, p. 172.

At the same place, in a two-days' hunt in Dec., 1899, 6,000 Rabbits were killed.[23]

These are but samples of hundreds of similar yet mostly unchronicled, affairs.

THE POISON WARFARE

But poison proved much more effective. The farmers' clubs of Crook County, Oregon [7,756 square miles], succeeded in killing by poison 59,000 Jackrabbits "during the winter of 1916-17, making a total of at least 134,000 Jackrabbits killed in this county alone since the campaigns there were first undertaken."[24]

During the year ending June 30, 1921, the Biological Survey reports that "in Lincoln Co., Idaho, [3,270 square miles] 168,166 Jackrabbits (by actual count) were killed by the use of 845 ounces of strychnine applied to suitable bait. . . . In spite of unfavourable winter weather conditions for the poisoning campaigns planned in Oregon, 25,000 Jackrabbits were killed and counted, besides many others that were not found."[25]

THE DRIVES

But by far the most destructive method is the driving—a systematic sweeping of the whole country by an assemblage of the whole population, arranged so that nearly all the Rabbits of the region are driven into the wings of a long chute, and ultimately into a corral in which they are slaughtered.

There were many drives of which no record was kept; but Dr. T. S Palmer tells[26] of 155 in California during the 8 years, 1888 to 1895, which resulted in the destruction of nearly 2,400 Rabbits per drive, a total of 370,195 Rabbits. Between 1875 and 1895, there were 220 drives in the States of Oregon, Utah, Idaho, and Colorado, which encompassed the destruction of 470,107 Rabbits.[27]

"Some of the early drives near Bakersfield took place on a ranch less than 1 square mile in extent. In the first drive, on the afternoon of Jan. 2, 1888, 1,126 Rabbits were killed; as soon as the animals were dispatched, the same field was passed over again, and 796 more were killed. A week later, on Jan. 10, there were two drives on the same ground, the first resulting in the destruction of 2,000 Rabbits, the second in more than 3,000; in the latter, an adjoining field was also driven over. It was estimated that altogether about 8,000 Rabbits were killed on this ranch in 9 days.

---

[23] John Miller, of La Junta, Colo., Recreation, Jan., 1899, p. 45.

[24] W. B. Bell of Biological Survey, Yearbook, Dept. Agr., 1917, p. 10.

[25] Ann. Rep. Biol. Surv. U. S. Dept. Agr., pub. Sept. 10, 1921, p. 9.

[26] Jackrabbits of U. S., p. 58.

[27] As above, p. 64.

"The Kern County *Echo* of March (8?), 1888, stated that a total of about 40,000 Rabbits had been killed in the drives about Bakersfield from Jan. 1, 1888, up to that date, and referred to an estimate that two-thirds of the Rabbits killed in the drives were females, and the average number of young of each of these was 3½. On this basis it was computed that had these 40,000 Rabbits lived 2 months, they would have increased to 135,000."[28]

A Jackrabbit Drive

One of the most destructive of these drives is thus described by W. W. H. MacCurdy:[29]

"The Rabbit drive of the San Joaquin Valley is an institution devised and continued from year to year to keep the enemy in subjection. There are usually several drives in a season, the first in February or March, and the last early in April. . . .

"In the regular drive, men, women, and children, on foot, on horseback, in wagons, buggies, and carts, armed with guns, whips, clubs, and missiles of every description, participate. On the day appointed for the drive, all the roads leading to the various places of meeting, at an early hour, are thronged with the people on their way to join in the day's sport. The corral of the latest drive was located about 13 miles southwest of Fresno, near the line of the Southern Pacific Railroad. From this corral, following the general direction of the railroad track, ran about 5 miles of wire fence, poultry-mesh. A like fence ran southeast several miles. These fences served as leaders to bring the Rabbits into the corral."

The farmers then assembled in three great lines, each 4 to 5 miles long, and under management of mounted marshals. When this army—centre and wings—was placed, it enclosed about 20 square miles of Rabbit country; and the drive began. "From the time the lines began to move, Jackrabbits appeared, with here and there a Cottontail or a Coyote. The Cottontails and Squirrels took to their burrows as the line came up; but the Jacks, except in rare instances, trusted to their legs to take them out of the reach of club and bullet. . . .

"All the morning, the shotgun men have been getting in their effective work on the Jacks skulking among the weeds or hiding in hollows along the ditches. Marching along from 10 to 30 yards in advance of the line of teams and stick-wielders, like skirmishers ahead of a line of battle, they blaze away at every Rabbit that comes within range. The plain behind the marching line is dotted with the carcasses of the slain.

---

[28] Jackrabbits of U. S., p. 24.

[29] Recreation, Jan., 1899, pp. 17–18.

"Every moment the number of visible Jacks increases, as they are routed from the weeds and grass, and sent scurrying across the plain. When the march first began, they appeared singly or by twos and threes; now they are in droves. Away to the Northwest rise up columns of smoke; the skirmishers have fired some tule-marshes, to drive out the cowering inhabitants. Shorter grows the line as the distance to the corral lessens; and denser becomes the swarm of frantic Jacks. The advancing line, doubled and redoubled in numbers as the enclosed area decreases, crowds the scared animals forward to the corral. The corral gate, only a few feet wide, furnishes a door of escape, and through it they pour in a solid stream, and spread out over its area.

"After the last Rabbit has passed into the corral, hundreds of men and boys rush in after them; the gate is closed and the massacre begins. The frightened creatures make frantic efforts to escape; they rush against the meshed barriers and along them, seeking outlet, until they become one great swirling mass, the sight of which makes one dizzy; they pile up in great heaps at the corners and die from exhaustion and smothering; they fall by the thousands under the quick strokes of their relentless pursuers.

"The slaughter complete, the mathematicians figure out estimates of the result. Oh the march, 50 Rabbits each to 300 shotguns—15,000; 5,000 killed by clubs and other missiles, and another 15,000 carted away from the corral; a total of 35,000 for the day."

These figures may be high, but we know that often half of this has been reached. And even at that—think of it! 17,000 soft, furry, little corpses! Terrible slaughter! But necessary if agriculture is to continue.

To-day

In southern California, where I saw such hordes of Jackrabbits in 1899, a different condition prevails, thanks to persistent warfare on the farmers' part. And I had supposed that elsewhere too, the Rabbit hordes were vanishing. However, Dr. A. K. Fisher writes me, March 29, 1927:

"In the West, to-day (1927) it is the same. Dry farmers are driven from their holdings. Live stock is being starved through the total demolition of stacks and growing forage by the Jackrabbit. Orchards and nurseries are being destroyed by ever-growing hordes of the devouring rodents.

"At Cedarville, Calif., during the latter part of Oct. 1926 (while I was there one Sunday), 6,000 Jacks were killed in a drive. In half a dozen of the Western States, one of our perplexing rodent control problems is to prevent Jackrabbits from destroying farm produce, forage, and fruit trees. Hundreds of thousands of skins are being shipped to the East for felting in hat manufacture, without visible effect on the Rabbit numbers. Probably within a couple of years, we will have urgent requests to control Jackrabbits in southern California where, in 1923, you found them almost wanting."

So also Major E. A. Goldman writes me under same date: "In northern Nevada last fall, in a region little modified as yet by man and his works, I found Blacktailed Jacks so excessively abundant that they were seriously injuring even wild fodder, including the sagebrush. California Rabbit drives could have been duplicated there; they remain in similar abundance elsewhere."

The Final Thought

Thus, I have aimed to set before the readers a fair statement of the case of Farmer vs. Jack.

I never saw one of these Rabbit drives. I shall go if the opportunity presents itself. I know I shall rejoice in the oncoming mass of living, bounding, bright-eyed wild things. I shall follow and gloat over the visible abundance of life—till we get to the corral and the final scene. Then I shall turn my back and go elsewhere. I suppose that grim slaughter is necessary, but my memory sadly conjures up the bygone days when all the West was one great field of game. I ride the ranges of my boyhood days, and now I find no living wild thing. So that, seeing the Rabbit host—menacent, crop-ruinous though it be—I find myself secretly exulting that still there is wild life teeming in the West.

References

1896—The Jackrabbits of the United States, by T. S. Palmer, Bull. 8, U. S. Dept. Agri., Div. Orn. & Mamm.

1906—Mammals of Great Britain and Ireland, by John Guille Millais, III, pp. 3–28.

1909—The Rabbits of North America, by E. W. Nelson, N. A. F. 29, pp. 129–58.

1912—Metabolic Water, Its Production and Rôle in Vital Phenomena, by S. M. Babcock, Research Bull. 22, U. of Wis. Agri. Exp. Sta., pp. 87–181.

1917—The Jackrabbit in California, by Mary C. Dickerson, *Amer. Mus. Journ.*, Jan., No. 1, pp. 71–75.

1923—Sources of Water Supply for Desert Animals, by Vernon Bailey, *Scientific Monthly*, Vol. XVII, No. 1, July, pp. 66–86.

LIFE XCVII ANTELOPE-JACK

PAGE
Names 764
Description: Size, Weight, Colour 764
The Callotis Group 765
Features 766
Range 767
Haunts 767
Numbers 767
Home Range 768
Mating 769
Forms and Nests 769
The Young 770
Enemies and Friends 770
The Meteor of the Plains 773
Sociable but Unsanitary 773
His Way of Life 773
When Our Ways Met 776

References 778

The Long and the Short of it.

Antelope-jack, White-flanked Jackrabbit, White-sided Jack, Blanket Jack, Saddle Jack, Mexican Jack, Mexican Jackrabbit, Burro-jack, Donkey-Jack, Texas Hare, Jackass Rabbit

Lepus alleni Mearns

(L. *Lepus*, a Hare; *alleni*, in honour of J. A. Allen)

Lepus alleni MEARNS, 1890, Bull. Amer. Mus. Nat. Hist., II, p. 294, Feb. 21.

TYPE LOCALITY—Rillito, Pima Co., Ariz.

"Antelope-jack" it used to be in Arizona, from the creature's general resemblance to the Pronghorn. Now it is "Burro-jack"; for the Antelope is fast becoming a thing of the past, a fading memory. As a simile, "Antelope" has lost all point; but the Burro, with his majestic ears, we have ever with us; and the name "Burro-jack" has a quick appeal, for it is dealing with familiar ideas, and it has the qualities of descriptiveness and patness.

When seen alive and afar, this superb creature seems simply a Jackrabbit of unusual size, exaggerated ears, and white flanks; a silver-gray animal with a brown mantle, a snow-white rear, and ears like wings. The absence of black tips to the ears, and the white which covers the sides—shoulder, flank, and rump—are strong diagnostic features of the species.

The Antelope-jack has, in addition to the generic characters, the following:

Size. Total length, $23\frac{3}{4}$ in. (606 mm.); tail, $2\frac{1}{2}$ in. (63 mm.); hind foot, $5\frac{3}{16}$ in. (131 mm.); ear from notch in dried skin, $5\frac{5}{8}$ in. (144 mm.). But the usual measurement of the ear from tip to notch is misleading, as, in life, this gives a length of only 6 or 7 in., whereas, by actual measurement from skull to tip of the ear, it is about 9 in.

Weight. Fresh specimens taken near Tucson, Ariz., in Jan., 1923, weighed $8\frac{1}{4}$, $7\frac{3}{4}$, $7\frac{1}{4}$, and $6\frac{1}{4}$ lbs. All were males.

Colour. In colour, the sexes are alike. The general impression is of a light gray animal, shading into pure white below. On the back, is a brown mantle or poncho through which the head is stuck; it passes around both sides of the neck, and down the chest to the breast, where it hangs like a sharply defined bib. The mantle is plentifully peppered and flecked with black on the back; on the sides, the peppering fades away; the brown bib on the neck and chest is not peppered at all.

The underparts are white, which colour is carried up on to the sides – shoulder, flank, and rump – and shows more in the living specimen than in the skin.

The head is much like the mantle, with whitish rings around the eyes. The iris is yellow-brown. Under each ear on the neck, is a white patch. The ears themselves are speckled brown above, with a white edging on the outer side of each; and are, as we have noted, without the usual black spot at the tip. (Plate XCIX, p. 756.)

The legs are white with gray trimmings outside. The tail is ostensibly white, and issues out of a white region; but, down from the mantle—here blackish—trickles a little stream of black ink, which, though nearly lost on the white, finds its way on top of the tail to the tip; thus maintaining the black tail tradition of its group.

The Callotis Group

alleni Mearns, largest of all. T. l., Rillito, Ariz.

tiburonensis Townsend, like *alleni*, of which it is a race, but darker and more iron-gray; buffness on back, pale, and overlaid with black. T. l., Tiburon Island, Gulf of California.

palitans Bangs, like *alleni*, of which it is a well-marked race, but much more brightly coloured; skull, larger. T. l., Aguacaliente, about 40 miles southeast of Mazatlan, Sinaloa, Mex.

gaillardi Mearns, much like *callotis* in size and general appearance; but differs in having nape, plain buff, without a trace of black, and upper parts paler, more vinaceous buff. T. l., West Fork of Playas Valley, Grant Co., N. M.

battyi Allen, similar to *gaillardi*, of which it is a race, but smaller, and upper parts paler, especially on head and neck. T. l., Rancho Santuario, Durango, Mex.

callotis Wagler, a medium-sized species; hair, coarse; upper parts, dark, slightly pinkish buff heavily washed with black; ears, white behind; nape, black; flanks and underparts, white; rump, gray. T. l., southern end of Mexican table-land.

flavigularis Wagner, much like *callotis*, but back more grayish, creamy buff; ears, buff behind; two black bands on nape. T. l., probably near Tehuantepec City, Oaxaca, Mex.

altamiræ Nelson, top of head and back, creamy buff, thinly washed with black; ears, white behind; nape with a broad black stripe from the back of each ear. T. l., Alta Mira, Tamaulipas, Mex.

Thus, the group consists of 5 well-marked species, with the first 2 divided into 3 and 2 races respectively. These 2 species, *alleni* and *gaillardi*, are the only ones that so far have been found within our borders. The habits of the whole group are alike in the main.

FEATURES

The gold-brown bib which hangs like a shield in front of the chest is backed by a skin of unusual thickness and strength, no doubt as a chest protector while rushing through the brush, or during the annual battles of the males.

The shifting of the mantle, noted later, is evidently done by the *panniculus*, or fly-shaker muscle; but dissection of several specimens showed that, though more extended than in other Rabbits, this muscle does not appear to be unusually large or strong.

On the belly, is a white nursery fringe, as described in the Blacktail Life (p. 737).

But his ears are his crowning glory—9 inches long, measured to the base, and 3 inches wide—the finest and relatively largest ears of any animal in America. (Plate CI, p. 771.)

On the under side of the ear, there is no fur; one clearly sees the fine-meshed veins and sentient membranes with their tingling nerve points. On all the upper parts, is a coating of very fine, close, brown hair, minutely peppered with black. Along the outer or lower side of each, is a marvellous bordure or "piping" of pure white velvet which goes right to the tip. On the opposite or inner side of the opening, is a fringe of coarse, whitish bristles, set like an exquisite comb.

One cannot see the creature crouched flat in its form, without realizing that, in this pose, these vast external ears are rainstorm roof rather than hearing apparatus. As he bounds away, they rise from the sides of his head like wings—the wings on Mercury's cap; and well may symbolize the creature's speed. But when one minutely examines the specializations and complexity of these wonderful external organs, one is forced to believe that they are more than roof—more than ears that they are carefully devised, developed, and perfected antennæ, intended to receive vibrations and wave lengths of many other kinds, as well as those we commonly call sound.

RANGE

The range of the Burro-jacks is, as shown on Map XVI (p. 607), the dry plains of the central Mexican table-land, from Sonora and Chihuahua on the north, with a slight invasion of Arizona and New Mexico, thence southward in the westerly part of Mexico to Chiapas on the Gulf of Tehuantepec. They range vertically from sea level at many places, to about 8,500 feet above, in northern Puebla. Faunally expressed, they fit into the Upper and Lower Sonoran, and into the upper border of the arid Tropical Zone—aridity having apparently more to do with their distribution than temperature.

Thus, these finest of the Jacks, these most intensified of all the group, find their home in the southmost part of the family territory, contrary to the rule; for, commonly, the extreme development of a group is somewhere near its centre of dispersal, or else in the coldest part of its range, where its food is, nevertheless, abundant.

Lepus alleni, that is here taken to represent its kindred, is found on the western coast belt of Mexico from Tepic northward through central Sonora, dying out as a long tongue thrust a hundred miles into central Arizona, reaching at least to Phœnix.

HAUNTS

There is no fundamental difference between the haunts of the Antelope-jack and those of the Common or Californian Jack. Independent of water, and averse to damp, they both seek the high, dry plains, where water and damp are practically unknown. Every little stipulation that the Californian Jack has made, concerning its home surroundings, has been adopted by the Antelope-jack; and insisted on in even higher degree, including the protection of scattering bushes. But the Blacktail is contented with soap-weed and sage; while the Antelope-jack, with larger ideas and larger problems, insists on an ampler defence against air attack as well as ground foes, and finds it in a fierce array of chollas and mesquite.

NUMBERS

As to its numbers, we have little information. The sum of that at hand shows the Antelope-jack to be scarce. The same melancholy sentence must be written of it as of all the big game in our country—"formerly common, now rare."

Nowhere in the United States except in Arizona, was it ever a regular game animal. Discussing its occurrence, Nelson writes:

"Formerly, the Antelope Jack-rabbit of Arizona was common on the plains about Tucson, where many were shot for rifle practice. They are now comparatively scarce in that district, and are never so excessively abundant as the common species of the West now and then becomes."[1]

It does, however, become numerous as soon as its deadly enemy, the Coyote, is suppressed, as the following shows: In 1922, the farmers north of Douglas, Ariz., were so much pestered by Jackrabbits which had greatly increased since the Coyote-poisoning campaign, that, in March, they organized a drive. In one day, they covered a region 3 miles wide and 5 miles long, rounding up and killing 2,000 Jackrabbits; the greater part were of the present species.

The next day, they drove the same region, and still found the creatures in considerable numbers, though markedly reduced. J. F. Kinney, of La Osa Ranch, was present at the first drive, but did not wait for the second to finish, so is not sure of the later figures.

The unevenness of their distribution will be seen in this: On Jan. 15, 1923, I travelled for 38 miles south of Tucson, on sage plains, and saw not one Antelope-jack; then, in about 50 acres of woodland, saw 40 in 1½ hours. Again, on Jan. 22d, I travelled 50 miles southwest of Tucson over ordinary Cattle range, and saw not one; then, in a low woods of a mile across, saw 20 or 30 in an hour.

Home Range

There is very little light available on the home range of the individual. The Hares are everywhere noted for their adherence to their native soil and their routine life. This, being a true Hare, likely conforms to the family habit. We know that a square mile covers the home range of a Californian Jack, so that it is probable that the Antelope-jack may remain contentedly all his days in a region of less than 2 square miles.

There is a suggestion of light in the following: "When driven from the forms," says Nelson, "they often run in a wide circle; and in the course of half an hour or more, may be detected returning slyly and watchfully from a direction nearly opposite to that in which they departed."[2] That is, they do not go far, and they return to their small home range as soon as seems safe.

---

[1] W. A. N. A., p. 486.

Mating

Rabbits are not held up as models of propriety in sex matter, as is attested by numerous rhymes, popular but unprintable. The Hares are probably on a slightly higher plane; and this is one of the most highly developed of the Hares. All high development tends toward monogamy; therefore, on general principles, the species should be monogamous.

Besides these broad considerations, the only light we have on the present subject, is offered by Nelson as follows: "White-sided Jackrabbits are frequently found in pairs, occupying forms in close proximity to one another."[3] Evidently, they have adopted the twin-bed arrangement.

Forms and Nest

It has been noted that the Californian Jack, like the Deer, has a place—that is, a locality—which it calls "home." But it does not make a nest for its young, as do the Cottontails. On the other hand, it does make beds, forms, or couches for its own individual use. These are scooped out under a bush or other cover, and are smooth, but not lined or otherwise tempered by art. The form of the Antelope-jack is much like that of its kinsfolk, but more modified to woodland life. From the number of forms seen, it is likely that each individual has several.

Again, the Californian Jack never makes a burrow, and never enters one except under stress and dire necessity, such as escaping or hiding from a foe. The Antelope-jack seems to be of another mind; at least, the following observations by Nelson would imply this:

"Like other Hares, the Antelope Jackrabbits occupy forms under bushes or in the shelter of little patches of coarse vegetation. The only exception to this rule I have seen, was west of the city of Guadalajara, on the Mexican table-land. There, one summer day, in the midst of a lovely open valley covered with short, velvety green grass, and dotted with scattered acacia bushes, a caracara eagle suddenly swooped down upon a young White-sided Jackrabbit. In mortal terror, the little beast dashed away at great speed, the caracara casting at it repeatedly from a height of 15 or 20 feet, and each time striking the ground just behind. The young animal ran not less than 500 yards, straight for a bush on a small bank, where it vanished as by magic.

---

[2] W. A. N. A., p. 486.

[3] As above.

"The caracara was close behind; and, alighting, ran round and round the trunk of the bush, craning its neck, and apparently as surprised as myself at the sudden disappearance. Riding over to investigate, I found, partly concealed by coarse grass, the entrance of a burrow large enough to admit an adult Jackrabbit. It extended almost horizontally into the bank for about 18 inches; and then, turning abruptly to the left, ended in a rounded chamber some 15 inches in diameter, in which the young Jackrabbit lay snugly ensconced. It appeared altogether probable that this burrow had been made by the old Jackrabbit as a shelter for her young, one of which in its extreme need, had again sought asylum there."[4]

If this surmise be correct, then is the Antelope-jack the only one of the true Hares that makes a burrow underground—that has learned the wisdom of flying, when in trouble, to the bosom of Mother Earth. All animals, however, in dire extremity, will seek refuge in a hole, no matter what their normal habit. So that we await further light.

The Young

The young are, as with the rest of the group, 2 to 4 in number, rarely more. They are born ready to run. The following record is one of the very few that are available to show their time and way of life:

On March 30, 1920, Prof. Charles T. Vorhies, of the University of Arizona, shot a female Antelope-jack (*alleni*) on the Santa Rita Range Reserve, south of Tucson. When examined, 3 unborn young were found. Their eyes were open, and they began breathing normally at once. All showed a disposition to suckle, and might have been raised; but no foster mother could be found in time.[5] Which meagre facts show that its reproductive history is much like that of its kinsfolk.

Nothing further is recorded concerning the growth and development of this remarkable animal.

Enemies and Friends

The eagles and large hawks are dreaded enemies of the Jackrabbits on all the open parts of their range. But, the Burro-jack, when in shelter of the armed and haven arms of cactus and mesquite, has little to fear from anything on wings. Every flesh-eating quadruped preys on him, of course; and reptiles devour the young. Against all of these, the sufficient defence is the Jack's speed, his protective colours, and his fecundity.

---

[4] W. A. N. A., p. 486.

[5] Journ. Mamm., May, 1921, p. 114.

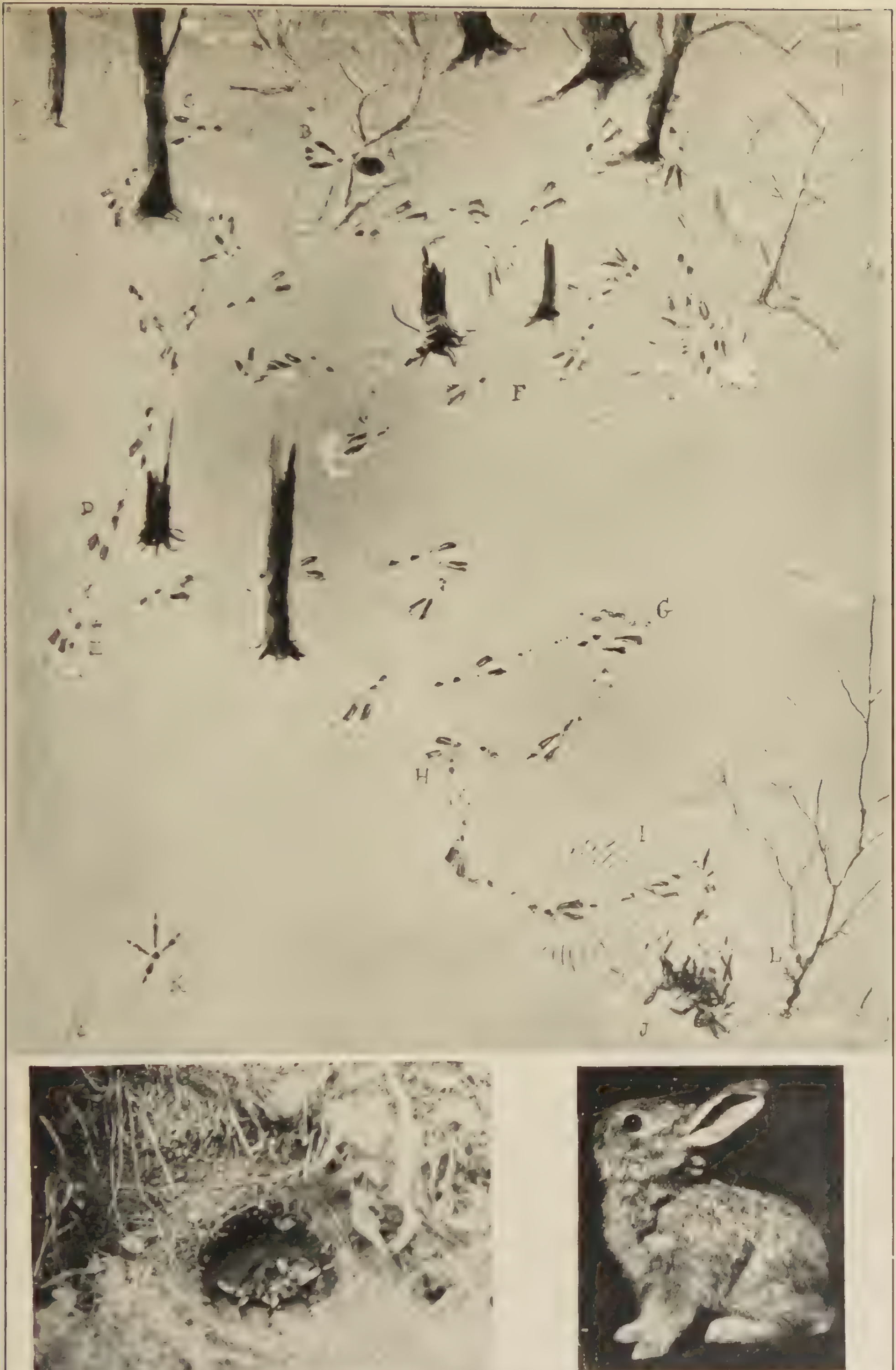


PLATE CIV.—COTTONTAIL TRACKS AND YOUNG

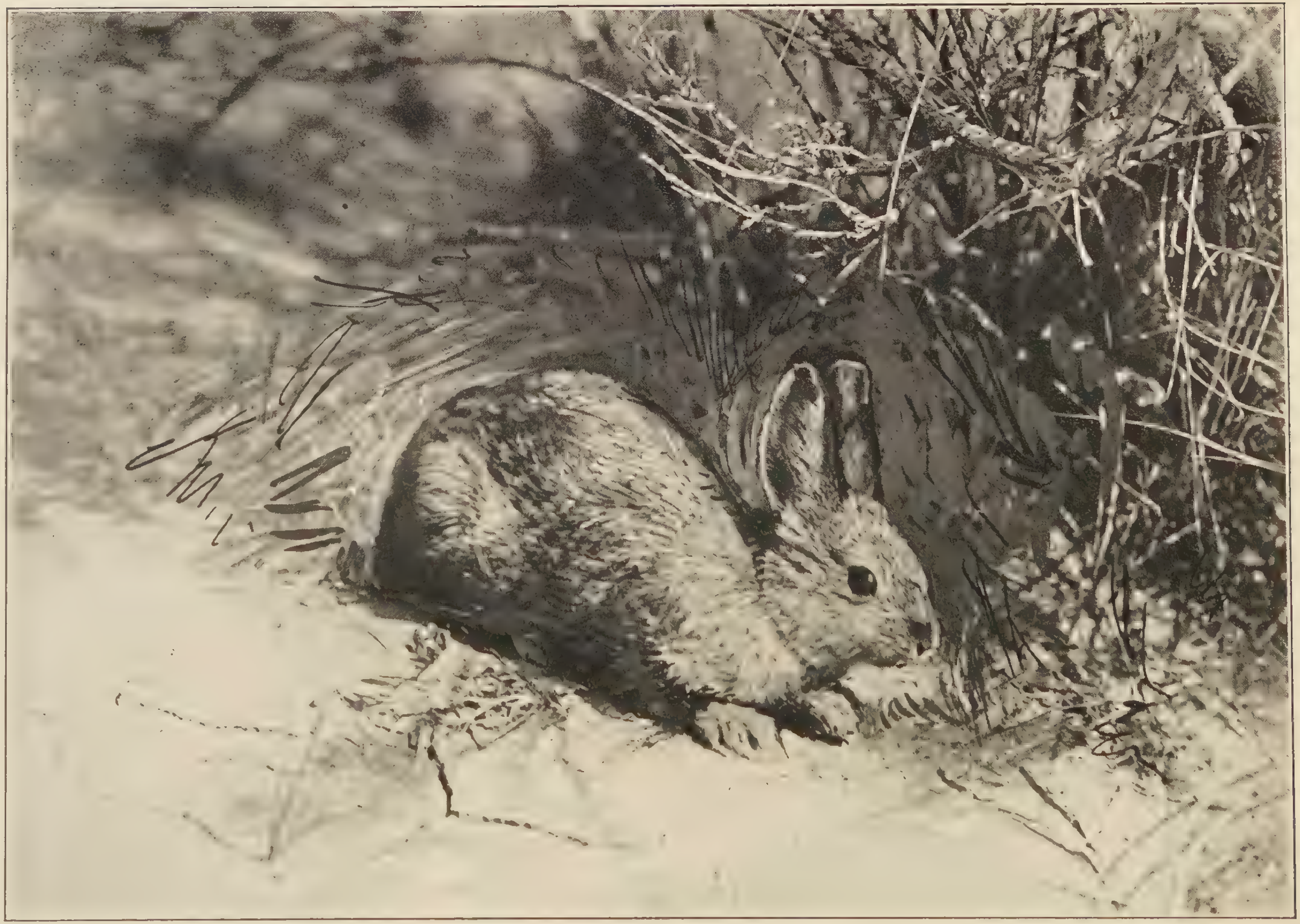


PLATE CVII. PYGMY RABBIT OF IDAHO

From photograph by Harold E. Anthony

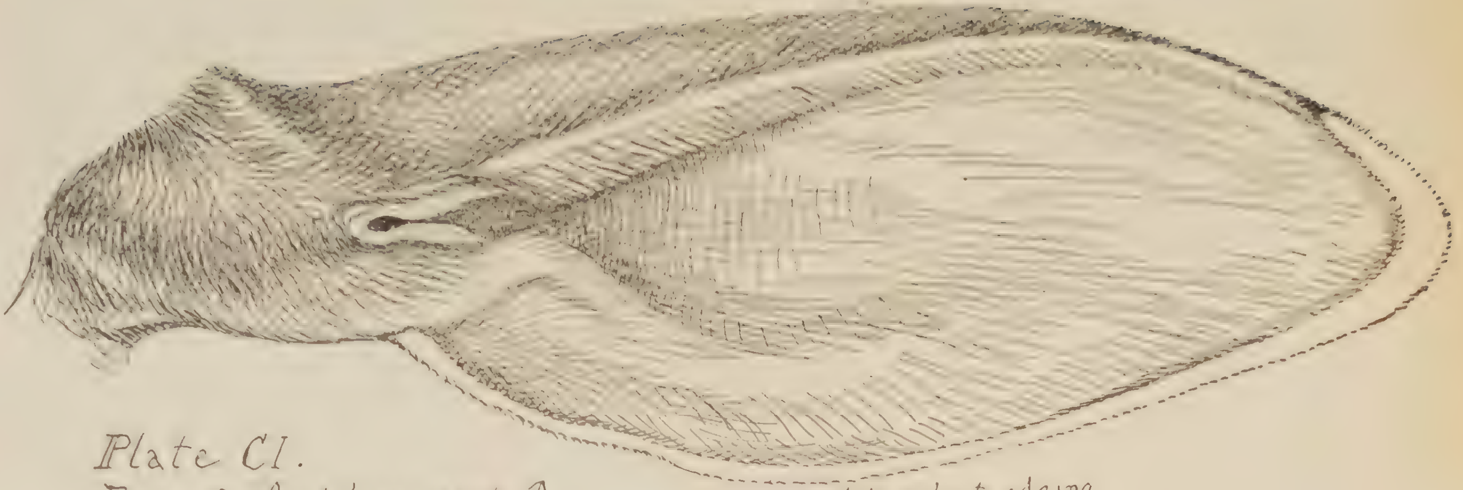


Plate CI.
Ear of Antelope-Jack ♂
Tucson. Ariz. 15 Jan. 1923. slightly reduced. E. T. S.

But the Coyote can go wherever the Jackrabbit goes, and his cunning ofttimes offsets the Jack's superior speed. J. C. Kinney, of Tucson, tells me that he has more than once seen the stratagem by which the Coyotes catch the far swifter Burro-jack. The pair—yes, the Coyotes usually work in pairs—go at an easy pace and follow the Jack; but keep on each side of him a hundred or more yards apart. The big white Jack goes bounding from the onset of Coyote No. 1, who is content when he has stampeded the Jack towards Coyote No. 2. As the fugitive comes near No. 2, the latter makes a determined rush, so the Jack is turned back at heart-breaking speed toward No. 1. That is, the Jack has to travel three or four times as far, and gets no chance to rest; while the Coyotes take it easy. At last, the Jack gets tired, the paralysis of terror sets in. The Coyotes close on him with a final rush, cut short his loud, hoarse "*qua, qua, qua*"—and the wise Wolves revel in their hot and bloody feast.

But the Blanket Jack's worst enemies are man and insects; against these two, his defences avail nothing. Rabbit drives, with their wholesale slaughter; motor cars, with their unfair speed; and long-range high-power guns that kill with certainty as far as one can see, are more and more in use against the doomed wild thing. He is nearly gone from the United States; his range in Mexico is shrinking.

The insect burden is evident on all sides, but of uncertain drain. Every one of the half-dozen Burro-jacks I have handled, had ears, face, and neck plentifully beaded over with seed-ticks—ticks that waste the frame by sucking the blood, and often repay their host by injecting into his impoverished veins the germs of fell disease.

Anyone who has travelled on the range of the Burro-jack, and realized the terrors of the myriad stinging, clinging, stabbing, clawing shrubs and vicious scraggly thorns, and the nightly need of tweezers to save him, body and limb, from the quills of these vegetable Porcupines, may well wonder if the Jackrabbits also do not suffer. He may ask, indeed, whether these grim, dagger-armed guardians do not sometimes, through life-long attitude or hostility, drive their poison poignards into the Rabbits that so long have looked to them for protection. The only present answer to this is that Coyote, Dog, Fox, Wolf, and many more are found with festering cactus wounds; but not one of the half-dozen Burro-jacks that I examined had a scratch or a hint of sting from any thorny plant.

Right marvellous is his speed, and seeming reckless in its impetuosity; yet, in the facts here given, we find ample proof that the Burro-jack knows what he is about—has learned the way of the cactus.

The Meteor of the Plains

As I watched one after another of these flashing "small Deer" go bounding by, I looked closely for the spy-hop or "Kangaroo-jump" that the other Jacks take when wishing to make an observation—to scan the world from a high lookout. But never once did I see it of the style that characterizes the Blacktail and Whitetail Jacks. At every fourth or fifth bound, the Burro did, indeed, make an exceptional leap; but its extent was forward, not upward. The reason is, no doubt, that, in the region where I saw him, he could not leap high enough to overtop the trees that are the cover round his home.

Nelson, however, is of the opinion that, in the open, they make spy-hops even higher than those of the Blacktail.

Sociable but Unsanitary

Nelson considers this animal as solitary as the Blacktail. Yet, on the day when first I met the species, I saw a pair, next 3 together, then 4, then 3 and 2 several times. Prof. Vorhies tells me that he has seen a string of 13 ambling along like Antelope; and this in midsummer, not the pairing season.

So far, I have little evidence that the Antelope-jack indulges in a dry-wallow, after the fashion ascribed to the Blacktailed Jack.

A first approach to the rudiments of sanitation is seen when a creature has a special place for the dung; the dung of this animal is scattered anywhere and everywhere in his haunts.

In other Rabbits, this habit has resulted in periodic epidemics. It remains to be seen whether the Burro-jack escapes the consequences of his ways.

Prof. Vorhies showed me a salt lick much frequented by these Hares. The deposit was of red clay, but I could get no taste of salt on putting it on my tongue.

His Way of Life

The Antelope Jackrabbit is the most intensified of all the tribe. Everything that a Texan Jack may be, the Mexican Jack is, in fuller measure. He is the biggest, longest-eared, farthest-leaping, brightest-coloured of all—the climax of the race. His, truly, are the wingèd head and the wingèd heels. Yes, and the wingèd heart, if we may gauge his zest of life by his superb bounding for the very joy of the mighty bound.

But persecution has made him scarce and shy. He is as hard to stalk now as an Antelope. Animals are usually shy in proportion to their size;

that is, in proportion to the pertinacity with which the meat-hunter pursues them; and this, the biggest of the long-eared Jacks, is, of course, the shyest of approach. He takes alarm mostly before the hunter is within gunshot.

Then, when he speeds away, as he has learned to do from anything that in the least resembles a man, he bounds so high, and makes such wonderful far-hops, that he gives a thrillsome picture of animal joy in animal power—an impression of a lithe, slick, and jubilant animalism.

And, as he goes, a baffling trick is seen. That big gray Jack turns into a white Jack as he sails away. Over some projecting ridge, he speeds in bounds of 20 feet. Then, if you follow softly, and unseen, and are equipped with good glasses, you may see afar the Jack—a Jack, but not a white one. This is brown; and only evidence—evidence in repeated abundance—will convince you that this is the same.

And herein lies the clue to his chameleon trick. By a muscular jerk, the buff gray mantle on his back was slid to the farther side; and the white of flank and belly drawn up, till all the side next us was shining white, and the other side mud-gray. Meanwhile, the black-topped tail was jammed against the rump, so only its outer rim, like a horseshoe of black, could be seen on the broad expanse of white. And the brown—whence came that change? Merely the broad brown ears upon his back, so positive that the gray was overpowered.

In the Californian Jack, we have seen the colour pattern used for alternately directive and protective colouration; but the Antelope-jack shows far higher specialization. Nelson, who first pointed it out, says: "The extension of the white on the sides of these species, assists in producing one of the most extraordinary examples of directive colouration known among mammals. I had the pleasure of discovering this one day in May, 1895, when hunting on horseback over the grassy plain bordering the Pacific coast of the Isthmus of Tehuantepec. As I rode slowly along, a big Jackrabbit hopped deliberately from its form in the grass a few yards away; and, by the contraction of a special set of muscles along the back, drew the sharp coloured dorsal area forward, and together, so that it formed only a narrow band on the middle of the back, with a corresponding extension of the white area on the rump and sides until, as the animal moved diagonally away, it looked almost entirely white.

"At a distance of 50 or 60 yards, it came to a stop, and expanded and contracted the dark dorsal area, thus producing a 'flashing' effect with the changing area of white on the sides and rump. This solved the riddle of the mirror-like flashes I had often seen, as Jackrabbits on the table-land had dashed away in the brilliant sunshine. The same habit of 'flashing' the white was afterwards observed in the species of southwestern New Mexico and southwestern Arizona, demonstrating the appropriateness of the name 'Antelope Jackrabbit,' given them by the ranchmen."[6]

Again, this same experienced naturalist writes: "This enlargement of the white area is always on the side turned toward the chance intruder, and accordingly, alternates from side to side as the animals slowly zigzag away. In the bright sunlight, the snowy white side flashes brilliantly, attracting attention from afar, and affording a fine example of directive colouration.

. . . .

"One individual . . . hopped slowly from its form, not 10 yards away, as I rode by on horseback, and, standing broadside, shifted the buffy dorsal area over, at the same time slowly drawing the white area up like a curtain until the side toward me was pure white, except a narrow buffy like along the top of the back. The Rabbit then hopped slowly along in the direction I was riding, but gradually moved farther away, keeping the white area in the same position until it had travelled 50 or 60 yards, when the colour areas slowly resumed their normal positions. I have seen *callotis* zigzag along, changing its course every 10 or 15 yards, and each time it turned, it flashed the white on the side toward me. I am inclined to think this flashing of the white is most frequent during the rutting time."[7]

Why this amazing change—the reverse of what one might expect? For the creature was protectively coloured as he hid; and now, as he bounds away, is blazoned with colours that are revealing and directive.

No doubt, as already noted in the Blacktailed Jack, he hid and his colours helped him, as long as hiding was helpful; but now since concealment is no longer possible, he deliberately uses every label mark that willl make him known, announcing plainly to Badger, Wolf, Coyote, and Fox that "*This is an Antelope-jack.*" They know that his speed is far beyond theirs, so save themselves the trouble of following. They give it up as soon as they see, and the net benefit is chiefly to the Jack, for it saves him daily a vast amount of unnecessary effort.

Emphasis of this thought is found in the fact that as he bounds away, the Jack is careful ever to swing his blazing national colours to the side that is next the foe, even though this entail a swift flop-over at every other bound. And one individual that I saw on the Santa Rita Plain, went zigzagging bounding from us and kept jerking the brown mantle from side to side like the saddle blanket of a runaway Horse.

---

[6] W. A. N. A., p. 486.

[7] Rabbits, N. A., pp. 115–16.

When Our Ways Met

My first meeting with the creature was on Jan. 15, 1923, near Tucson, Ariz. Prof. Charles T. Vorhies and family took me in their car to the Range Reserve, 38 miles south of the town, and at the foot of the Santa Rita Mountains.

On the road there, we passed much range that seemed suitable for the Antelope-jack, but never a one did we see. About 4:30, we reached a gently sloping country covered everywhere with the gold of the stiff dead grass; but thickly sprinkled over with feathery mesquites, alternating with the fantastic forms of sahuaro and barrel-cactus, prickly pear, chollas—woolly to look at and deadly to touch—catclaws and chaparral. Every tree and shrub in sight was defended with claws or poison, but everywhere the plain was spread with the gold of the precious winter grass. The country recalled East Africa, with its prairie slopes and wait-a-bits, the land of Giraffe and Baboon.

Partly wooded is the Santa Rita Range, and furnishes an ideal home for the wonderful Antelope-jack. Under every bush, the ground was pebbled over with the big, round "sign"; under, through, and among the low trees everywhere were the straight, narrow pathways of the Jack—6 inches wide —wonderfully straight when compared with the meandering trails of Kangaroo-rats and Cottontails; and flung across the land in one vast net.

Almost immediately, we saw a Jack under the ever-friendly thorn-bush, lying still and gray as a big gray clod, roofed over with two shingles, broad and brown. As we were in a car, he allowed us to come within 40 feet; a man on foot cannot get within 200 yards. When we stopped, he stood up on all four legs, high like a Deer. Now, the two broad shingles hoisted, became translucent, blunted spear-blades that blazed like wings of flame above his head; for the low sun was shining through them, and their blood-flush shone like wine.

Travellers in Africa have given an insight into their extraordinary mental reactions on first seeing the Giraffe. "What, that—a living creature! That tall, blasted tree, a thing of flesh and blood!" Though prepared for it, they were unprepared; and a shock, a joyful shock, is theirs, with the thought that follows fast: "And I am privileged to see this wonder of a by-gone day." Some such emotional overwhelm, in less degree, is the experience of those who, for the first time, see the Antelope-jack on his plains. He is so long, he sits so high, his ears are so enormous; and in the fantastic glamour of the desert setting and the evening light, he seems gigantic as he stands up-poised on those long, thin legs, like an Assyrian silhouette, or an Egyptian god incised on stone.

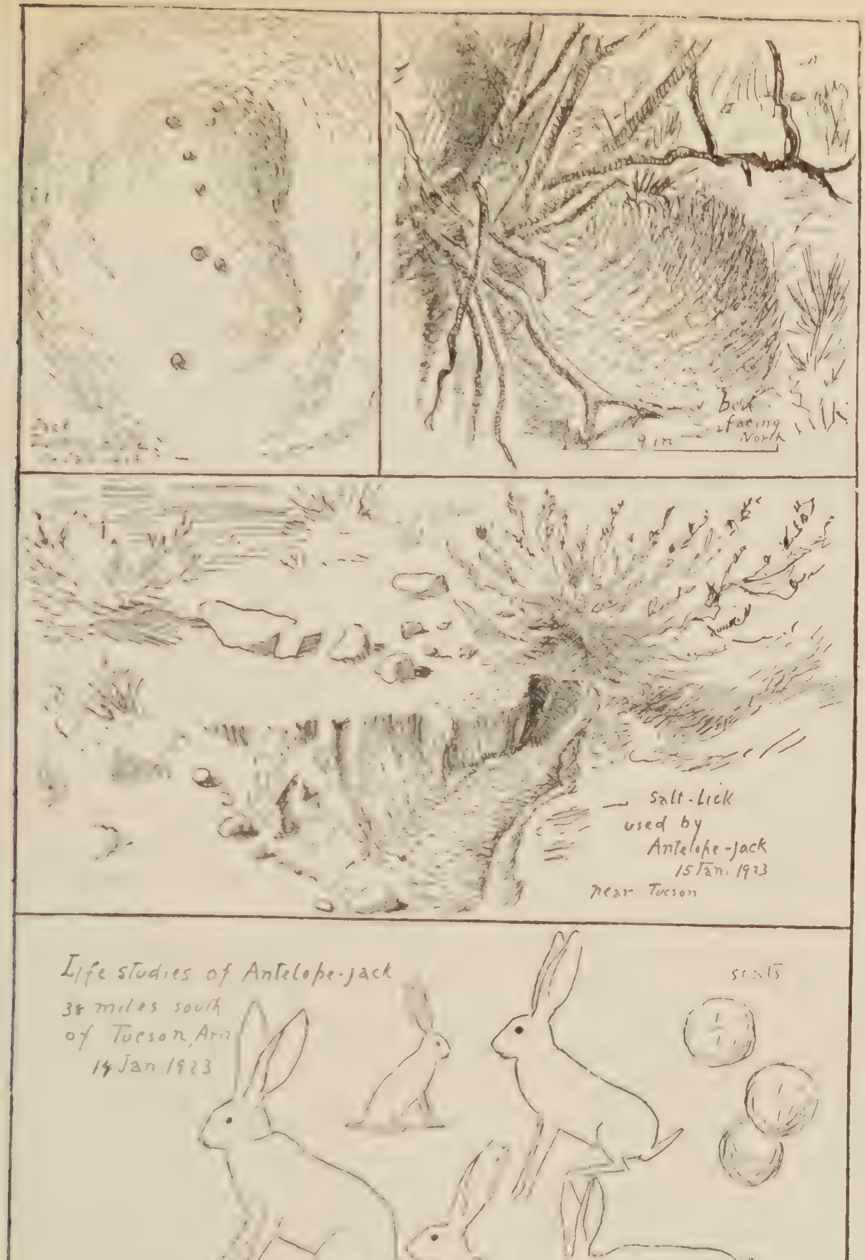

Bed facing North
9 in
Salt-Lick used by Antelope-jack 15 Jan. 1923 near Tucson
Life studies of Antelope-jack 38 miles south of Tucson, Ariz 14 Jan 1923
scats

Plate CII. Details of Antelope-jack.

Another thought looms big as one gazes. "I am a part of all that I have seen," moaned an ancient and celebrated traveller, as though he thought that he had discovered a distressing condition peculiar to himself. As a matter of fact, we are, all of us—yes, every living thing—a part of all that we have seen and dwelt in.

The Antelope-jack is a part of all that he has seen. His daily life is among the weird and fantastic forms of the desert—the strange and wonderful growths of giant cactuses, suhuaras, yuccas, cresote bushes, fouquerias, palo verde—the towering mesas and pinnacles sculptured by the eternal sand blasts into forms cathedralesque, into mosques and minarets, devils' towers and dining tables; glinted with volcanic glass, rosy with vermilion, green-bright with copper-stain, impossible, wonderful, matching the bizarre vegetation unlike anything else on earth, and dry, dry, bone-dry.

In this, his native setting, the Antelope-jack is natural and at home. His extraordinarily long legs, long ears and long bounds, seem just what one might expect as the thing created of such and for such a realm unique.

The world about it is the mould in which Dame Nature cast the slowly flowing, mingled slag of each new race; and when the fluxed amalgam gets so cold that it no longer flows or bends, it breaks with any change. Is the Burro-jack confronting such a change?

On that memorable day, we saw about forty Jacks in the hour and a half that passed before the sunset, glorious behind the purple peaks of Arizona, gave place to dusk. Under the ragged, angular mesquite, the first one was descried, as we have seen. He rose, and for a moment stood, a statue of blazing white with red-hot ears up-cocked. Crack! and the vast, up-pent energy of his sinewy limbs was lashing in the death convulse.

One cannot but feel guilty as the struggle slowly ends. The bright gold-brown eyes still shine and seem to look. But his high-strung life is ended, the beautiful Burro-jack is a corpse. Yes, I can salve my conscience by saying that I will save his skin and skull for the museum; but that wonderful body will be thrown away. Here, indeed, are 1,000 cardinal facts bound up and offered in that snowy skin. But—thanks to my ignorance—I salvage only 2, and throw away the 998. May I be forgiven, and wiser men come by before it is too late.

REFERENCES

1909—The Rabbits of North America, by E. W. Nelson, *N. A. F.* 29, U. S. Dept. Agri., pp. 117–26.
1918—Wild Animals of North America, by E. W. Nelson, p. 486.

LIFE XCVIII—COTTONTAIL

PAGE
Names 781
Kinships 781
Description: Size, Weight, Colour 782
Races 782
Range and Northward March 784
Haunts 786
Small Home Range 786
Freak Rabbits: Moose Bell, Abnormal Teeth, Horned Rabbits . . . 786
Fur and Flesh 788
The Hunting of Molly 788
Voice and Signals 788
Molly's Meals 789
What Rabbits Do Not Eat 790
The Barking of Trees 790
The Defence 791
Cottontail Cannibals 792
Speed and Cunning 793
Freezing 794
Swimming and Diving 794
High-strung Nerves 795
The Ghost Rabbit and Strange Weaknesses 796
The Cottontail's Foes 797
Stories of the Trail 798
Insect Enemies and Others 800
Disease, Sanitation, and Age 800
The Cottontail's Friends 801
The Bunny Billions 801
Form and Burrow 803
Winter Dens 806
Temper 806
Tamability 807
Mating, Bearing, and Nest 807
The Young and Their Care 808

PAGE
After Leaving the Nest 812
Brave Molly Cottontail 812
A Private Letter 813

References 815

"MOLLY FREEZING"

Cottontail, Cottontail Rabbit, Wood-hare, Wood-rabbit, Gray Rabbit, Molly Cottontail

Sylvilagus floridanus (Allen)

(L. *silva*, a forest; Gr. *Lagos*, a Hare; L. *floridanus*, of Florida)

Lepus sylvaticus floridanus ALLEN, 1890, Bull. Amer. Mus. Nat. Hist., III, p. 160, Oct. 8.

Sylvilagus floridanus LYON, 1904, Smiths. Misc. Coll., XLV, p. 336, June 15.

TYPE LOCALITY—Sebastian River, Brevard Co., Fla.

MEXICAN, *Conaro.*

The genus *Sylvilagus* (Gray 1867) comprises Rabbits and Hares whose young are born blind, naked, and helpless, to be nursed in a nest for a week or more before able to see and run. They have, moreover, many peculiarities of skull and of bony framework. All show the peculiar Cottontail pattern, described later.

KINSHIPS

The latest authorities recognize 10 species of Cottontail, divided into 44 races.

For a study of life-history, it will, however, be better to assume one superspecies—the Cottontail—of which there are three well-marked groups:

The Common Eastern Cottontail (*floridanus*), largest of the 3; of a certain pattern described later, and general brownish colour; with 16 races and 3 closely related species described.

The Rocky Mountain Cottontail (*nuttallii*), smaller; pattern the same, but of paler buffy colours; with 3 races described.

The Desert Cottontail (*auduboni*), standard pattern still clear, but of very pale ashy or buffy colours; palest of all, with 12 races described.

Besides which, there is the *cunicularius* group in Mexico, with 4 races.

Those who wish to study their minute differences are referred to Nelson's monograph as listed.

The Common Cottontail (*Sylvilagus floridanus*), in addition to the generic characters, has the following:

Size. Total length, 16 to $18\frac{1}{2}$ in. (406 to 470 mm.); tail, $1\frac{3}{4}$ in. (44 mm.); hind foot, $3\frac{9}{16}$ in. (90 mm.); ear, height from notch, in dried skin, $2\frac{3}{16}$ in. (55 mm.).

Weight, of specimens taken in northeastern New Mexico, ♂, 2 lbs., $2\frac{1}{2}$ lbs., $2\frac{3}{4}$ lbs.; ♀ $2\frac{1}{4}$ lbs., $2\frac{1}{2}$ lbs., $2\frac{1}{2}$ lbs., $2\frac{1}{2}$ lbs., 2 lbs. 10 oz.

Two ♂s bought at Duluth, taken in southern Minnesota, $2\frac{3}{4}$ lbs; and 3 lbs.

Specimens from Lorne Park, near Toronto, ♂s, 2 lbs. 12 oz.; 3 lbs. $1\frac{1}{2}$ oz. (Feb.).

Specimen from Long Island, N. Y., ♂, 2 lbs. 3 oz.

A full-grown ♂ taken at Victorville, Calif., Mar. 19, 1923, weighed 2 lbs.

Note that the heaviest was a ♀ taken in February.

Colour. A specimen taken at Nyack, N. Y., Dec. 4, 1895, is coloured thus: All above, soft buffy, deepening into sienna on the crown, cheeks, nose, legs, collar, back, and upper tail; all below, pure white, especially the cotton under the tail. On the hip, a triangular patch of sienna which is an island on the pale buff of the flank; all above, peppered plentifully with black hair-tips. The sienna on nape, front of fore legs and back of hind legs very deep and pure without any peppering. Ear, grayish buff with whitish lining, and a thin blackish outside edging which is nearly complete. Feet, whitish with dull gray brown under-sides.

Otherwise expressed, this is the Cottontail pattern: A mantle of peppered brown, sharp-edged against flanks of peppered buff; a separate patch of back colour on each hip; clear white belly; legs bi-coloured buff and white, but not peppered; tail, back-coloured above, and white beneath.

This pattern is found in all the group; but is not found outside the group, excepting dimly in the near kinsmen, *aquaticus* and *palustris.*

Races

floridanus Allen, the typical form. T. l., Sebastian River, Fla.

mallurus Thomas, larger, with longer ears than *floridanus;* less black, and more reddish above; legs paler. T. l., Raleigh, N. C.

hitchensi Mearns, like *mallurus,* but much paler. T. l., Smiths Island, Northampton Co., Va.

mearnsii Allen, in size like *mallurus,* but much paler, and ears shorter. T. l., Fort Snelling, Minn.

similis Nelson, like *mearnsii,* but smaller, paler, and more grayish buff. T. l., Valentine, Cherry Co., Neb.

alacer Bangs, in size like *floridanus*, but paler and redder. T. l., Stilwell, Adair Co., Okla.

chapmani Allen, one of the smallest; like *alacer*, but grayer, with shorter ears, and slenderer feet. T. l., Corpus Christi, Tex.

holzneri Mearns, larger than *chapmani*, much grayer, ears larger, feet more heavily furred. T. l., Huachuca Mts., Ariz.

subcinctus Miller, much like *holzneri*, but smaller, and with shorter ears. T. l., Hacienda El Molino, Michoacan, Mex.

restrictus Nelson, like *subcinctus* in size, but much redder; rufous on legs, stronger than in any other Mexican table-land form. T. l., Zapotlan, Jalisco, Mex.

orizabae Merriam, smallest and darkest gray of the Mexican subspecies; like *chapmani*, but darker. T. l., Mt. Orizaba, Mex.

connectens Nelson, large, nearly equalling *aztecus;* but with larger ears; general reddish colour. T. l., Chichicatle, Vera Cruz, Mex.

russatus Allen, of medium size, and reddish colours; with short, dark ears, and dark rufous legs. T. l., Pasa Nueva, Vera Cruz, Mex.

aztecus Allen, larger than *floridanus* or *russatus;* coloured like *russatus*, but brighter on hind legs; much longer ears. T. l., Tehuantepec City, Oaxaca, Mex.

chiapensis Nelson, largest of the races; pelage coarse; like *aztecus*, but darker and duller. T. l., San Cristobal, Chiapas, Mex.

yucatanicus Miller, much like *chiapensis* in size and colour; but paler and less intense. T. l., Merida, Yucatan.

cognatus Nelson, a large, gray species, much larger than *holzneri*, with large feet and ears. T. l., Manzano Mts., Valencia Co., N. M.

robustus Bailey, a large, pale species; grayer and much larger than *holzneri;* feet, large and thickly furred; skull larger than in *cognatus*. T. l., Davis Mts., Tex.

transitionalis Bangs, a small species, like *floridanus;* coloured like *mallurus;* but differing from all other Cottontails in the uniform pinkish buff or ochraceous of upper parts. T. l., Liberty Hill, New London Co., Conn.

The last 3 are considered distinct species.

RANGE AND NORTHWARD MARCH

Map XX (p. 785) sets forth sufficiently the vast range of the Cottontails in primitive times. But within 50 years, the Eastern Cottontail has greatly extended its holdings northward—perforce northward, since it came from the south, and had already spread from sea to sea.

The Ontarian invasion by the Cottontail is well known. In primitive forest days, the only Rabbit in Eastern Canada was the Snowshoe. Near Niagara, as Chas. W. Nash told me long ago, the Cottontail appeared first about 1871. Old residenters of Peel Co., near Toronto, told me that the Cottontails first appeared about 1872. In 1887, I found them regularly established, and common in Peel Co.

Writing of the species in Wellington and Waterloo counties, J. Dewey Soper says:[1] "This animal is not a native species, having entered Ontario with the clearing of the land sometime around 1870. Nash[2] first saw it along the Niagara River during the winter of 1871–72; while it was first recorded at Toronto, according to Fleming[3] 13 years later. Brooks, quoted by Miller in 1897, says that the Cottontail was common at Guelph, and that it had recently extended its range north nearly to Mount Forest. Today, it is relatively plentiful in suitable localities throughout both counties, and widely hunted in season."

Since then, it has steadily increased its territory, as the Snowshoe has retreated; and is now found, as indicated on the map, in all the Alleghanian region of Ontario.

In New York and New England, it has had a similar history. Formerly, it barely entered southern New York, Connecticut, and the southern border of Massachusetts. It has followed the settlements, and is now found throughout New York, excepting in the Adirondacks; throughout Connecticut and Massachusetts, and in southern Vermont. In New Hampshire, it is "abundant south of White Mts."[4]

In Maine, it is found in the "extreme southwestern" corner.[5]

In Michigan, it is now found nearly throughout the Lower Peninsula. M. M. Green records it for Montmorency Co.[6]

In Minnesota, it has spread from the Mississippi at Fort Snelling.

---

[1] Journ. Mamm., Nov., 1923, p. 245.

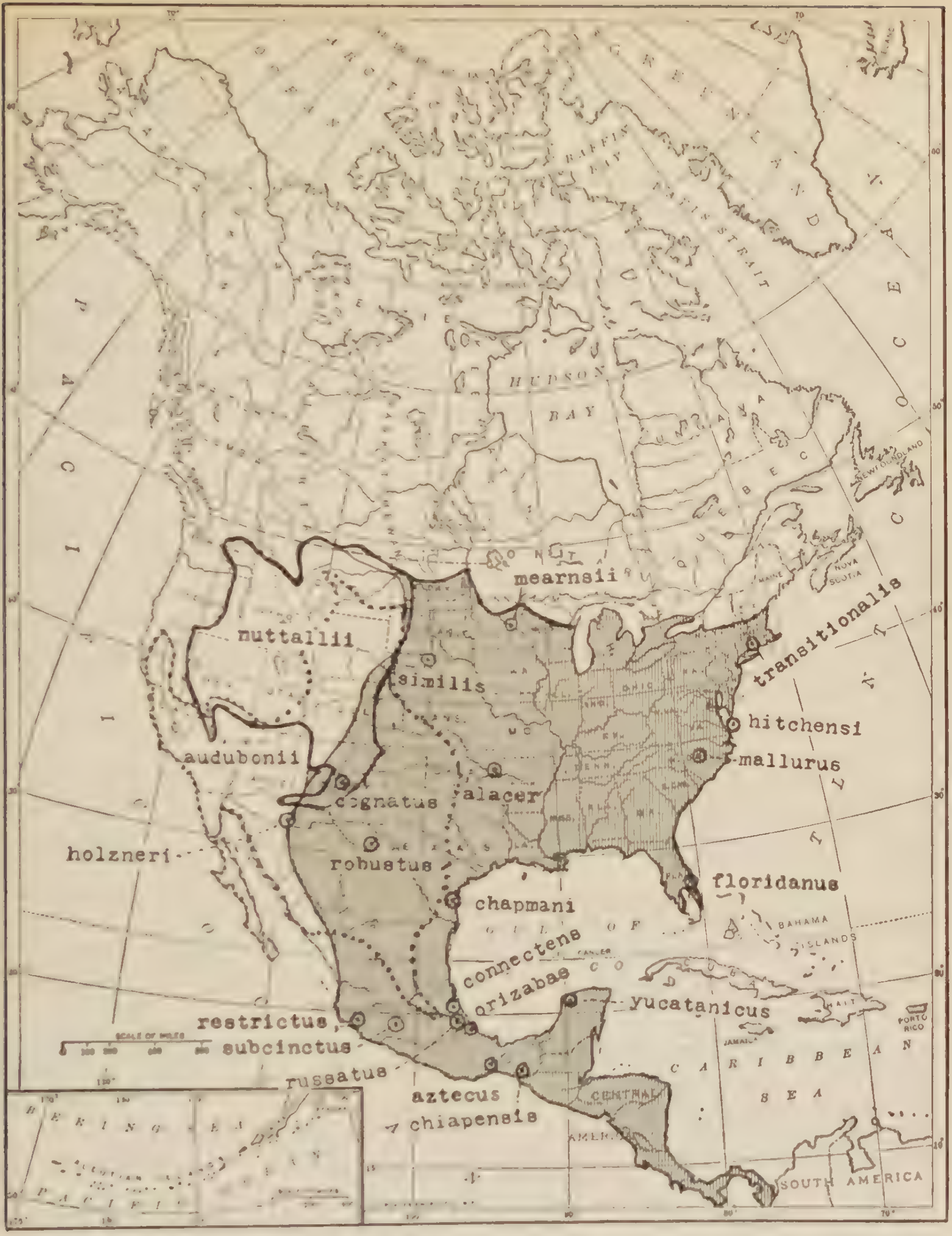
[2] Vertebrates of Ontario, 1908, p. 84.

[3] Mammals of Toronto, Ont., reprint, Nat. Hist. Tor. Region, 1913, p. 2.

[4] C. F. Jackson, Journ. Mamm., Feb., 1922, p. 15.

[5] Nelson, Rabbits, p. 196.

[6] Journ. Mamm., Aug., 1925, p. 178.



MAP XX.—RANGE OF THE COTTONTAILS IN NORTH AMERICA

By E. T. Seton, with assistance of the Biological Survey, 1927.

The range of the Common Cottontail (*floridanus*) group is given in tint. The range of the Rocky Mountain Cottontail (*nuttallii*) is in solid outline. The range of the Western Cottontail (*audubonii*) is in dotted outline. For fuller details, see Nelson's *Monograph of the Rabbits.*

northeastward to Duluth, where I found it occasional in 1908; and northward as far at least as Leech Lake. In 1887, according to Bailey, it had reached Fort Sisseton, S. D.[7]

It has not yet been recorded from Manitoba, but it is to be expected there; for it is a successful species everywhere spreading, and Manitoba is largely in the West Alleghanian Fauna.

In Saskatchewan, it has already appeared. P. A. Taverner writes me, Sept. 12, 1922: "We got Cottontails in the Cypress Hill country, in southwest Saskatchewan; also on lower Red Deer River in southern Alberta."

These records imply a northward extension east of the Rockies, of at least 100 miles beyond the boundaries shown in Nelson's map, 1909.[8]

Haunts

This is essentially a species of the borderlands, neither forest nor plain. It is fond of places overgrown with young pines, thickly crowded together, or thickets of briers and brambles. It rejoices in ill-kempt farms and plantations; and occupies, by preference, the coppices and grassy spots in the neighbourhood of cultivation. But it is not contented with a home in unbroken forest.

Small Home Range

All who have watched individual Cottontails closely, are struck by the smallness of their home range. I think it is probable that a Cottontail, unless driven afar by hounds or Foxes, spends its whole life within the limits of an acre.

It usually has a routine that it holds to for days at a time, following the same little paths, and feeding at the same places; so that, if you saw a Cottontail at a given place last night, you are likely to see it there again this evening.

Like all Rabbits, the species has regular pathways which it follows. These it incidentally improves by wear, as well as by cutting such new growths as tend to block them.

Freak Rabbits

Moose Bell. In the collection of James H. Fleming, of Toronto, is a belled Cottontail; that is, a Cottontail with a skin-bell on its throat (Plate CV, p. 805) much like that of a Moose. The bell is 2½ inches long. The second figure shows the sections. Nothing is known of its origin or use.

---

[7] Trip Through Minn. & Dak., 1888, p. 446.

[8] Rabbits, p. 43.

Abnormal Teeth. Freaks with excessively grown teeth are common in the Rat and Mouse world; but, so far, I find but one case among the Cottontails. Dr. G. T. Runcies, of Roachdale, Ind., sends me the details under date of March 19, 1917. The picture (Plate CV, p. 805) speaks for itself. The history of such freaks is usually this: The incisors of rodents have persistent pulps, the teeth grow very fast and continuously, to allow for great wearing down through use. If the opposite incisor be broken, or, in some way, be prevented grinding on its mate, or if there be insufficient use of any one tooth, its growth continues unchecked till it becomes a sweeping half-circle or more, greatly inconveniencing the owner, or even causing his death.

In the Cottontail case here given, the lower incisors are present, and the explanation of the unusual growth is not clear.

Horned Rabbits. The horned Cottontail is a well-known freak. The horns are a morbid product of the skin, and seem to be the result of irritating attacks by a skin parasite. These growths are of no particular service to the owner; and will hardly be interesting until someone more fully explains their origin.

A specimen with 6 horns was taken by Jim Brennan, a rancher on Red Bird River, north of O'Neill, Neb.[9] One of these horns was 2 inches long.

Another Cottontail with 5 distinct horns—the largest 2½ inches long, the smallest ½ inch—was taken by Guy W. Von Schriltz, of Cold Water, Kansas, in Oklahoma, Dec., 1916.[10] A third, with but 2 horns, was killed on Salt Creek, Choctaw Co., Okla., 3 miles from Hugo, by Evans De Weese, of Hugo, about May, 1917."[11]

In Denver Museum (F. C. L. 3304) is a local specimen of Cottontail that has, all told, 15 horns. These consist of 5 well-marked horns from 1¼ to 1¾ inches long on the head; and 10 groups of low, horny points situated, 1 on the nose, 1 on the throat, 1 in each armpit, 1 on each flank, 1 in each groin, 1 on pubis, and 1 on rump. The head only is illustrated here (Plate CVI, p. 811).

An exaggerated case is one which I examined at Denver in the collection of William R. McFadden. It was killed at Stratton, Neb., about March 10, 1901. It had 16 horns distributed as follows: on the crown, 2; on the right cheek, 9 of various sizes; on the left upper lip, 1; on the chin, 1; on the rump, 3 of large size—that is, very thick and short, also irregular. The largest was that on the upper lip, 1⅞ inches; that between the ears was 1⅝ inches. All were hard, rough, fibrous, and black, not unlike Antelope horns that have been weathered. This was the second horned Cottontail McFadden had seen.

---

[9] Forest & Stream, April, 1917, p. 162.

[10] As above, June, 1917, p. 261.

[11] As above.

Fur and Flesh

The pelt of the Cottontail has not yet found a place in the world's markets, for the skin is too tender for service, and the fur is deficient in the qualities of durability and gloss.

Its flesh, however, is everywhere in demand. Not to be compared with venison and sundry other wild meats, it is yet toothsome, nutritious, wholesome food. In the arid sage lands of the Southwest, the creature sometimes overdoes the sage-seasoning during its lifetime.

The Hunting of Molly

The Cottontail is the big game of the small boy. Be he trapper, chaser, or gunner, the first great triumph in his caveman life is usually the taking of a fat Bunny.

Found in nearly all parts of the United States, able to maintain itself on and about the farm—even on the prairies—this is the one game creature worthy of the name, that we have always and everywhere with us.

In the Northeastern States, the Cottontail is pursued with Dogs, and either shot on the run, or taken by hand from the stone wall, hollow tree, or Woodchuck hole to which it may have been driven.

In the Southern States, the creature is generally hunted with pointer Dogs, then routed from its form under the brushpile or the brier patch, and shot as it bounds away.

Bunny is wholly guileless in the matter of a trap. A snare placed on the trail, or in the gaps of some fence, is soon or late, the Rabbit's undoing. A box-trap with apple bait set in the barnyard or in the near woods, is another plan that every small boy uses.

Some game animals can carry a lot of lead. Deer and Bear can go a long way with a mortal wound; yes, a hundred yards or more, with a bullet in the heart. But the slightest touch of the deadly stinging shot tumbles poor Molly head-over-heels, to run no more. I know of no other creature of vigorous life that is more easily killed—that often dies, indeed, from mere shock.

Voice and Signals

Though furnished with a larynx and vocal cords, the Cottontail seems to turn them to little account. It signals rarely with its voice, and uses it but sparingly to express emotion. Every hunter is familiar with the long squeal, "*qua-a-a-a*," that little Rabbits especially are ready to utter when caught; and most of us have seen the distressed mother come running to do her poor best for the baby in peril.

As later noted, the Cottontail that attacked the dead Skunk continued to utter his "*qua-a-a*" war-whoop.

Kennicott says "that, in fighting or playing together, the males produce a low, purring sound scarcely above the breath."[12]

F. and A. Brooks, writing on the weird nature sounds at night, say: "Quite rarely, the common Cottontail Rabbit, when startled at night, will utter a shrill whistle which many do not recognize; and there is sometimes heard from the woods in chill February evenings and nights, a long-drawn hollow trill which we have heard attributed variously to the Rabbit, Raccoon, and screech-owl. Undoubtedly, the screech-owl is the author of this note, yet we have been informed by experienced woodsmen that they have witnessed a Rabbit uttering the same sound."[13]

In my own Journal, I find the following: Greenwich, Conn., June 19, 1921. This evening, in Cow Lane, saw 2 Cottontails. Both stamped, and uttered a little squeak as they went off. This I heard twice quite clearly, and was within 15 or 20 feet of them at the time.

Most of their signalling is done by stamping with their hind feet. Anger, challenge, and fear are, in some degree, so expressed, because we get reactions in the other Rabbits who hear the thumps.

To some extent, also, the Rabbits use rubbing posts, that is, certain trees, stumps, etc., on which they leave their personal odour as a notice to other Rabbits.[14]

MOLLY'S MEALS

To make a complete list of the plants that serve the Cottontails as food, would mean a catalogue of *99* per cent. of the flora of the United States. Instead of offering such an array of names, I shall give a summary of their food habits, then deal with the exceptions.

Nearly every kind of green grass, succulent herb or flowering plant, native or foreign, is acceptable food to the Cottontails. Clover, wild and crop, and alfalfa are special favourites; growing crops of wheat, rye, peas, cabbage, and lettuce are eaten, though seldom in a degree harmful to the yield, because at that season other foods are abundant.

Shoots, sprouts, buds of growing trees and bushes, tendrils and leaves of vines are on the list; and, in the desert regions, the leaf buds of cactus, also the leaves and twigs of mesquite.

---

[12] Quads. Ill., p. 79.

[13] Forest & Stream, May, 1921, p. 209.

[14] See Wolf Wireless, Vol. I, p. 286.

In the late summer, they eat berries, soft-shell nuts, cabbage, turnips, cornstalks; in winter, dry grasses, shoots of low bushes, field crops still on the land, leaves and bark of evergreen plants, and many kinds of trees.

What Rabbits Do Not Eat

This is a much shorter list. So far as I can learn, the Cottontails do not ordinarily eat such poisonous plants as hemlock, nightshade, etc.; nor do they eat toadstools. They care little for grain, and do not eat hard-shell nuts because they cannot. I never knew a Rabbit to eat burdock; and it is often said that burrs cause much trouble to these animals by getting in their wool. In the far Southwest, they do not eat the creosote bush. In the Californian forests, they commonly reject the incense cedar (*Libocedrus*), although exceptions appear. Prof. David E. Lantz says:

"The incense cedar (*Libocedrus decurrens*) of California, long reputed to be exempt from attacks by Rabbits, when planted by the Forest Service in the San Gabriel National Forest, was badly injured by Cottontail Rabbits."[15] This he explains as follows:

"Usually the apparent immunity of a tree from the attack of Rabbits is to be taken as indicating that other trees growing near it, are preferred; for when an entire plantation is of a single species, its apparent immunity often disappears."[16]

The Cottontails do not dig in the ground for bulbs or roots. Normally, they do not feed on flesh, fish, reptiles, or insects; and there is no record of Cottontails destroying bird-life in any form.

The Barking of Trees

Much calamity-howling has been heard over the barking of orchard trees by Cottontails. This raises a grave problem, but its terrors have been magnified.

There can be no question that Rabbits do cut off the twigs within reach. But this is a trifle, maybe no damage at all, for twigs so low are undesirable. Next, the largest proportion of the damage through girdling attributed to Rabbits is really done by Mice. In my own grounds at Greenwich, Conn., nine-tenths of the rodent damage to orchard and plantation trees has been traced to Mice, chiefly *Microtus pinetorum.*

---

[15] Farm & Orchard, p. 333.

[16] As above.

To a casual glance, the mischief done by the two is the same, but one can nearly always tell which was the criminal by certain features:

First, the wounds made by Rabbits have large toothmarks, and the bark next the wounds commonly hangs in strips.

Second, the Rabbit work is above the snow and up high; that of the Mice usually begins at or below the surface of the ground.

Third, the dung pellets are strong evidence.

Fourth, the tracks in the snow or dust are like criminal finger-prints.

Fifth, one might cite the probabilities as evidence; for they are 3 to 1 that it is Mouse work.

THE DEFENCE

Granting that the Rabbits are guilty as charged by the "howlers," there are three answers: (a) Destroy the Cottontails; (b) Protect the trees; (c) Compromise with the Rabbits—that is, make a treaty.

(a) Who would extirpate the Cottontails, even if he could? Who would rob the woods of a joyful flash of wild life? Who would rob the nation of an annual food supply worth $25,000,000? Who would rob 10,000,000 sportsmen of the one abundant, universal, worth-while game animal we have left?

Probably no one would calmly elect to do any of these selfish things. And, even if he would, he could not do it. It is impossible.

(b) The second answer is—protect the trees. Frank C. Pellett, of Atlantic, Iowa, writes to file a similar complaint against the Cottontail for tree girdling, but has the wisdom to acquaint us with a simple remedy. "Cottontails," he says, "are very abundant in this part of the State; and in winter, cause serious damage to young fruit trees.

"Several washes have been recommended by various fruit-growers to prevent injury, but they are of little value, except as a temporary expedient. I have found fresh blood to be more effective than any other wash. The best protection, however, is a wrapper of wire screen or tin placed around the body of the tree."[17]

Another method much used now out West and in Australia, is surrounding the orchard with a rabbit-proof fence of wire netting. This is quite effective.

(c) In my young days in the backwoods of Canada, we were much troubled by Rats gnawing harness. Evidently, Rats, like Porcupines, need salt; what they got out of the harness were the sweat-salts from the Horses. It was simple to meet their need in another way. This we did by putting common table salt in various places around the stable, so that the Rats let the harness alone. This was striking a bargain, making a treaty with the Rats.

---

[17] The Cottontail, p. 291.

A similar solution for the Rabbit trouble is offered in the following: "Feeding Rabbits in winter to prevent attacks upon orchards," says Lantz, "has been successfully practised, on the theory that it is cheaper to feed than to fight them. One plan is to leave the winter prunings of apple trees scattered about the orchard. Another is to furnish corn, cabbage, or turnips in sufficient quantities to feed the Rabbits during cold weather. These methods have considerable merit, particularly the former, which seems to give excellent results when both Mice and Rabbits are present."[18]

With the same thought in mind, we may say that Cottontails are so fond of alfalfa and soy beans, that a crop of one of these is a guarantee of immunity to nearly everything else that grows in the garden.

COTTONTAIL CANNIBALS

Of all creatures treated in this work, I should have thought the Cottontail furthest removed from the possibility of cannibalism, excepting, perhaps, the Horned Ruminants. So that the following by A. C. Thatcher, of Urbana, O., gave me an unpleasant shock: "Last winter, during the time of our big snow," he says, "a Cat caught a Rabbit close to my barn. I heard the Rabbit squalling, and drove the Cat away before she had killed her victim, but Bunny died that night. In the evening, it snowed again, covering all old tracks. The new snow, next morning, gave a clear account of what had occurred during the night. I found the partially eaten carcass of the Rabbit lying 20 feet from where it had died. Its flesh hung in long, fine shreds or strings—just such work as I should imagine a Rabbit would do with its long, sharp teeth; and not a track of anything but Rabbits was to be found. Neither Cat, owl, nor any other beast or bird had set foot in the snow near that place.

"I tracked 4 Rabbits from there, and jumped them all within 50 yards. I am as certain that carcass was eaten by Rabbits as if I had seen them eating it."[19]

Corroborative evidence is found in the fact that a similar habit is ascribed to the Snowshoe Rabbit. Also, those of us who have kept domestic Rabbits, know that such things occur in the "hutch"; though only when the little ones are too small to look like Rabbits, and under circumstances which evidence some morbid condition. The records indicate that all animals (except the Horned Ruminants) will do the same thing when under similar stress.

---

[18] Farm & Orchard, p. 342.

[19] Recreation, Nov., 1902, p. 383.

Speed and Cunning

A Rabbit never runs or trots, in the way that Dogs or Deer do. She hops or bounds. In a fair race, straightaway across open, flat country, the Cottontail would stand no chance at all against a Dog, a Fox, a Coyote, or a Wolf. But Molly is not foolish enough to expose herself to any such unnecessary risk. Her first burst of speed may be as good as that of a Fox, for she has immensely powerful hind legs, and back muscles of unusual proportions. She can leap 10 or 15 feet at a bound, and cover two bounds in a second—for a time. *But she cannot keep it up.* Half a mile of such a pace, and she is at the end of her strength; especially if there be soft snow; and now, the fine art of misleading a trailing enemy is brought into play. Nothing else could be her salvation.

In my story of Molly Cottontail, I have set forth the many clever tricks that are used by Rabbits. These were not imaginary, though, of course, they were generic, not individual. I have seen each and all of them used many times by different Rabbits.

Kennicott, after large and varied experience, expressed the same ideas. "When pursued," he says, "an old male exhibits as much cunning as a Fox—doubling, turning aside, and permitting the Dog to pass, and then running on the back track; going through water, which it dislikes; and frequently, springing upon a log, and sitting motionless; while the Dog, in plain sight, beats around within a few feet of the spot.

"Usually, when one of these animals is started by Dogs, it runs a short distance; and, unless closely pursued, turns aside and stops. The Dog generally passes it, when it at once returns to the neighbourhood of its form; or, if unable to do so directly, an old one will frequently manage, by repeated doubling, to elude its pursuer, and reach its form again by a circuitous route. Should it be closely followed by a fleet Dog, it will make for a burrow, or a hollow tree, which has an opening at the ground into a cavity extending some distance above, up which it forces itself by bracing against the sides.

"Young Rabbits are not so apt to double and attempt to turn back to their forms, but often run immediately to a tree; and an old one will sometimes take to a hole without much doubling, especially if it has before been chased, and found refuge in the same retreat."[20]

---

[20] Quads. Ill., p. 79.

The straightaway, with nothing but speed, is, then, of little use to the Cottontail, as we have seen. The many tricks of doubling back and side leaping are effective. But even these are unravelled by a clever hound, and then the game is up, for Molly has little "bottom," while a bred hound can run all day.

But one more trick has Molly, that is, "hole up." The den of a Woodchuck or a Skunk is this final, safe retreat; and safe it is if the occupant be a sleepy Woodchuck, or if the Skunk be elsewhere.

FREEZING

Every hunter knows that freezing is an established trick of woodcraft, among wild animals as well as among his own kind. When in the woods, a hunter becomes conscious of the nearness of another creature, his first duty to himself is "freeze"; that is, remain still as death till he has found out who the other creature is, and what is his intention. This freezing is absolutely essential to wood-life. Most animals are good at it; Deer are wonderful. But none of them can beat Molly Cottontail. In illustration of this, I give an incident from my journal:

Greenwich, Conn., June 18, 1914. At 7:40, as I went through the woods at dusk, a Cottontail hopped on to the path. He froze; so did I. I glanced at my watch, and timed him. For 2 minutes 35 seconds, he never budged nor winked, so far as I could see. Then he sank down on his hindquarters, and continued unmoving until 5 minutes was up. Now he seemed to shake a mosquito from one ear, but continued until 8 minutes 30 seconds had passed, when he again shook one ear. After a few seconds, he repeated the shake, and at 7:55 he hopped away. During all this time (15 minutes), I had stood, and moved but little, except to kill some mosquitoes.

Another note, made Jan. 18, 1905, implies that the Cottontail never winks, or else does it too quickly for observation. "To-day, I watched a near-by Cottontail for 2½ minutes, and it did not once wink. I have never seen a Cottontail wink, or close its eyes. When I struck a sharp blow on a near board, the creature seemed to droop the upper lid a fraction of an inch, but not more than one-tenth of the distance necessary to cover the eyeball."

Again: *June 13, 1906.* To-day, I watched a Cottontail that froze 6¼ minutes. Then I got tired. He did not even wink, so far as I could tell.

SWIMMING AND DIVING

The Swamp-rabbit and the Water-rabbit are, of course, much at home in the water; the Snowshoe and the Prairie-hare can swim when they must, and frequently take to the water when they want to get to the other side. It is not surprising, therefore, to find Molly Cottontail swimming at times. The following instances show that she can do it very successfully, though it seems not to be her choice among modes of travel.

Norman A. Wood, of Ann Arbor, Mich., writes me:[21] "I once saw a Cottontail jump into a small stream, and swim across; and, so far as I could see, this was . . . voluntary."

Charles King of Frontenac, Minn., writes me: "In the summer of 1880, at Frontenac, Minn., I saw a Cottontail chased by boys, plunge into a little bay of Lake Pepin, and swim for a sandy point nearly 50 yards away. I never saw such a thing before, or thought it possible; for every Hare, chased by Coyote or hounds, that ever before came under my eye, would double on his tracks, or dart to right or left the instant water was sighted ahead; and this I have noticed along the Verde in Arizona, the Tongue and Yellowstone in Montana, and the Wind River in Wyoming."

The last and strongest incident was given me by J. H. Winscanley, of Kempton, Ind. When a boy, he saw a Cottontail swim the Ohio River at a point 5 miles above Willsville, where the river is half a mile wide. It was so exhausted that he easily caught it; but next day, he let it go. He did not see it enter the water; only coming out; but is satisfied that it came across from West Virginia.

Diving is close kin to swimming, even though it be into the snow. "Mount Tom," a writer in *Forest & Stream*,[22] says: "Not long ago, I saw a Rabbit play a trick on a Dog that I never saw done before. A Dog ran a Rabbit into the road, and it came near running under my Horses, but jumped back; and the Dog came near catching it, but it dove into the snow out of sight. The Dog grabbed into the snow where the Rabbit went, but did not get it. Then the Dog put its head into the snow above its eyes, and pushed along in the snow. The Rabbit came out of the snow three feet from the Dog, and went under a bridge. When it went out of sight, the Dog stood there wondering how it was done."

High-strung Nerves

In discussing the powers of the Cottontail, one is confronted by the extraordinarily high-strung nature of his nerves. Timid at all times is he, and extremely sensitive to sudden loud noise. The following incident is an example; in this, the bang of the gun apparently resulted in motor paralysis:

Four sportsmen from New Jersey, were shooting in Virginia, when several Rabbits ran across the path. One of the men offered to bet he could catch the next Rabbit that crossed. The wager was no sooner made than out bounded a bunny. "John's chance had come. He leaped from the wagon, and entering the tall grass, went flying after the Rabbit. The shouts of the judges and referee were so boisterous that the Rabbit stopped to learn the cause of the commotion. So amazed was he at the wild antics of the onlookers, that he forgot his own safety until pounced upon by the sly John, and seized by the ears."[23]

---

[21] Dec. 30, 1914.

[22] April 19, 1897, p. 284.

The next incident is by Charles G. Blandford. He says: "Upon two occasions, I have known Rabbits to die of fright. While walking through the fields with a friend, armed with an old musket, he had shot at a hawk, and was reloading as we walked along. I had in my pocket a paper bag of shot. The powder was rammed home, and while fishing for the shot, to expedite matters, he fitted on the cap. At that moment, a Rabbit started out of a patch of high grass and briers in front of us. Jack raised the old musket; and not waiting for the shot, which I held in my hand, took a snap shot at about 20 yards, and the Rabbit rolled over. We thought, of course, the wadding had been aimed, balled, and struck the Rabbit in the back of the neck. That was not possible, for we found the pieces of newspaper which comprised the wadding lying about where we stood."[24]

The Ghost Rabbit and Strange Weaknesses

One night, in the August of 1888, I was out with my hound in the woods near Springfield-on-the-Credit, Ont. Uttering the familiar short yelps that meant "Rabbit," the Dog rushed into a brier patch; but at once, came back, shouting, "Help! help!" and took refuge at my feet. At the same moment, from the other side of the brier patch, went out a Rabbit all right —*but a snow-white one*. Now, Dogs are not supposed to be superstitious; but, on this occasion, Ranger acted precisely as though he had seen a ghost.

A similar incident is reported to me by Lionel Pearce, of Stonebridge, England. His terrier rushed on a cat-trail into a lobby, but came forth with yells of terror, when confronted by an undismayed and snow-white kitten.

Testimony to a strange weakness is found in the following instance; I cannot prove or disprove the statement. J. R. M. B. says:[25] "When a North Carolina darkie sees a Rabbit sitting in its form, he calls another one who, under the direction of the first, approaches the Rabbit from behind.

---

[23] S. P. L., Leesburg, Va., Recreation, Nov., 1898, p. 363.

[24] Forest & Stream, Feb. 18, 1899, p. 127.

[25] As above, Feb. 4, 1914, p. 207.

The Rabbit only notices the one in front of him; and he either stands still or moves very slowly, and not towards the Rabbit. The darkie approaching from behind, has no difficulty in seizing the Rabbit with his hands."

THE COTTONTAIL'S FOES

A touching story in fable form comes back to me now from childhood days in the old log school-house. It told of the Hare so harmless "that every creature was her friend." Alas, for the cold light of research and its heartless revelations. Now I realize that the Wood-hare, our Molly Cottontail, is so harmless that every creature is her enemy. I do not know of a flesh-eating beast, bird, or reptile in the Cottontail's range, that does not look upon her as an easy, lawful, and desirable prey. One need not list them; all do it.

Even the Skunks take their yearly toll of the Cottontail, chiefly through destruction of the helpless broods when in the nest; though occasionally, the slow Skunk captures the swift Cottontail through the latter's making the mistake of hiding in a hole.

The Mink is well known to destroy many Rabbits, both by seizing them in the form, and chasing them into a burrow. Kennicott says: "I have repeatedly observed the track of the Common Mink for a great distance, as it wound about logs and brush-heaps, often entering hollow trees and burrows, sometimes following a Rabbit's track, till finally I have come to where an unhappy victim had been pulled down from a tree in which it had in vain sought refuge."[26]

In another case, he notes that several Rabbits made their headquarters under a barn, and were making sad havoc among the choice plants in the garden. But a Mink came by, and cleared them out for which he received the farmer's blessing.[27]

The following note, sent me by Wallace Evans, of St. Charles, Ill., April 26, 1913, seems to have been a case of "tamed by fear," just as a Panther and a Deer may continue together on a small island in flood time.

"While keeping a live Mink some time since in my specially constructed cage," says Evans, "I was unable to catch any live Rats to put in to him, but happened to have caught a live Rabbit that day, and put him in the cage instead. To my surprise, at the end of two days, both the Rabbit and Mink were huddled in opposite corners of the cage, neither one apparently taking any notice of the other. When I put live Rats into the cage, they are always very quickly killed by the Mink, but the Rabbit was absolutely untouched."

---

[26] Quads. Ill., p. 82.

[27] As above, p. 84.

Among the enemies that have the knack of making all the world hate them, are the Weasels. The Weasel is such an incarnate demon of brutal destruction that everyone sympathizes with the Cottontail, when the tracks of the two are seen in the snow, racing—the Cottontail to escape, the Weasel for the fell delight of taking life.

The Cottontail can escape hawks, owls, Foxes, Wildcats, Coyotes, Dogs, and men by taking to a hole in the ground. But, alas, for the day when it seeks in that way to escape from a Weasel. Any chance of safety that it had while afoot in the open, is now gone. The Weasel promptly seizes his victim. In vain, the Rabbit jambs its nose into a far corner to keep the blood-sucker from its head and neck. This only prolongs the agony, and whets the Weasel's appetite for the inevitable blood feast.

The final chapter in a race for life had an unexpected ending in a case reported to me by Prof. W. H. Sherzer, of Ypsilanti. It seems to show that the Cottontail is so terrified of the Weasel that, to escape him, she will face any other foe or take any other chance. "Last summer (1910)," the Professor writes, "my friend and fellow camper at Base Lake, Mich., was Prof. Frederick C. Hicks, of Cincinnati. He heard a most pathetic outcry, and rushed from his cottage to the front porch; and there saw an ordinary Cottontail Rabbit rushing up the narrow path, straight for the cottage, with a Weasel attached to its leg, and swinging back and forth as the Rabbit leaped. He was not in sight when the Rabbit started; but the Rabbit came straight for the cottage, and did not swerve when my friend reached the edge of the porch. The Weasel held on till about 4 feet distant from Hicks, when he let go, gave a vicious look at him, and scurried into the grass. The Rabbit continued his course, went under the porch just beneath where my friend was standing, and disappeared under the cottage; he had certainly gained his point, and saved his own life."

In spite of all these fierce, destructive foes, the Cottontail continues with us. Three reasons there are for this: first, her enormous fecundity—one pair may easily become 100 Cottontails during one year, if none are destroyed; next, her speed afoot; and last, the keenness of her senses.

Stories of the Trail

In the winter of 1901, I was at Goat Island, Niagara, and there saw a nearly complete record of a Mink pursuing a Cottontail through the snow. The two tracks, obviously made the night before, led under a great pile of logs and brushwood, and neither came out; so that there can be little doubt that, in the depths of that labyrinth, were lying the body of the Rabbit partly devoured, and not far away, the Mink, well fed and curled up comfortably asleep.

Another tragic record of which the track evidence was complete, I observed at Toronto, Feb. 15, 1885. I give it in full, but have shortened the trail where it was uninteresting. (Plate CIV, p. 798.)

At A, I found a round place about 5 inches by 8, where a Cottontail had crouched during the light snowfall. At B, he had leaped out, and sat looking around; the small prints in front were made by his fore feet, the two long ones by his hind feet; and farther back, is a little dimple made by the tail, showing that he was sitting on it.

Something alarmed him, causing him to dart out at full speed toward C and D. Now, a remarkable change is to be seen: the marks made by the front feet are behind the marks made by the hind feet, because the Rabbit overreaches each time; the hind feet track ahead of the front feet. The faster he goes, the farther ahead those hind feet get; and what would happen if he multiplied his speed by ten, I really cannot imagine. This overreach of the hind feet takes place in most bounding animals.

Now the Cottontail began a series of the most extraordinary leaps and dodgings (D, E, F) as though trying to escape from some enemy. But what enemy? There were no tracks. I began to think the Rabbit was crazy—was flying from an imaginary foe—that, possibly, I was on the trail of a March Hare. But at G, I found for the first time, some spots of blood. This told me that the Rabbit was in real danger, but gave no clue to its source.

A few yards farther, at H, I found more blood. Twenty yards more at I, for the first time, on each side of the Rabbit trail, were the obvious marks of a pair of broad, strong wings. Oho! now I knew the mystery of the Cottontail running from a foe that left no track. He was pursued by an eagle, a hawk, or an owl. A few yards farther, and I found the remains (J) of the Cottontail, partly devoured. This put the eagle out of the question; an eagle would have carried the Rabbit off bodily. A hawk or an owl, then, was the assassin. I looked for something to decide which; and close by the remains, found the peculiar two-paired track of an owl. A hawk's track would have been as at K, while the owl nearly always sets its feet on the ground with two toes forward and two toes back.

But which owl? There were at least three in the valley that might be blamed. I looked for more proof, and got it on the near-by sapling—one small feather (L), downy, as are all owl feathers, and bearing three broad bars; telling me plainly that a barred owl had been there lately, and that, therefore, he was most certainly the slayer of the Cottontail.

As I busied myself making notes, what should come flying up the valley but the owl himself—back to the very place of the crime, intent on completing his meal, no doubt. He alighted on a branch 10 feet above my head, and just over the Rabbit remains; and sat there muttering in his throat. I had neither gun nor camera; but he sat very still for a long time, and a sketch book was at hand, so I made a careful drawing.[28]

INSECT ENEMIES AND OTHERS

Kennicott observes:[29] "Many Rabbits are infested by the larvæ of a large gadfly (*Œstrus*), and are hence said by hunters to have the 'wolf.' In their fur, live astonishing numbers of a peculiar flea, apparently differing from the common species."

Two cases of the warble or gadfly grub have I seen. One was in a male Cottontail that I got at Duluth, Dec. 3, 1908. It had an immense warble on its breast under the skin; and a second, a male, that I got near Tucson, Ariz., Jan. 22, 1923, had two huge living warbles side by side in its shoulder.

A new and unsuspected enemy is noted in the following from my journal: "On Nov. 7, 1920, I motored from Austin to San Antonio, Texas, some 82 miles. On the road, evidently killed by motors travelling at night, were 4 Cottontails, 2 Dogs, 2 Rats, 1 Possum, and 1 very large Skunk. It is remarkable that the Cottontail commonly suffers more than any other game animal from motor cars."

DISEASE, SANITATION, AND AGE

That the Cottontail is subject to the devastating plagues which periodically destroy the Snowshoe Rabbit, seems likely; yet no proof of it is at hand.

In Cal. F. & G.[30] is a long article by Prof. E. Ralph De Ong, of the University of California, detailing the parasites and diseases of Cottontails and Brush Rabbits. Among the insect and minute pests are wood-ticks, fleas, bot-flies, ear-mites, tape-worms, and sporozoa; with a list of consequent diseases or disablements. These seem to become rife as soon as the Rabbits are greatly multiplied in a given locality; but burn out as their hosts are reduced. It is as though nature had set an absolute embargo on great numbers without perfect sanitation.

In sanitary matters, the species has made little progress. Its home, being merely a nightly bivouac, is next morning found recklessly pebbled over with the scats of its recent evacuations.

---

[28] This appeared in Country Life in America, Dec., 1909, p. 246.

[29] Quads. Ill., p. 82.

[30] July, 1919, pp. 142–43.

A captive, which I kept for observation, dropped 125 pellets in one night; and urinated once, or perhaps twice. Another, a captive from Kansas, dropped 5,400 pellets in the two weeks ending April 20, 1926.

The Cottontail takes the periodic and tonic sunbath, but is not known to indulge in dust or water bathing.

Probably 6 or 7 years is the limit of age that is attained.

THE COTTONTAIL'S FRIENDS

The brier bush, the cactus thicket, and the thorn patch are the Cottontail's best natural friends. Where these abound, the Cottontails prosper; and where these are cleared up, the Cottontails pass away.

Man, destructive man, has, strange to say, lined up with the Cottontail's friends. First, he has made such a devastating war on Molly's enemies; second—and this is no small matter—his iron imitation of the thorn bush—that is, the barb-wire fence—has served marvellously to save and propagate the Cottontails in the far open prairie countries where once the species could not maintain itself. I look forward with confident expectation, to see the Cottontail in all the barb-wire country of the wheat-land that forms the Great Canadian Northwest.

Two other mighty and man-made protections the Cottontail now has: The sanctuaries that are being set up in many parts of the country; and the strong and growing sentiment which inspired the establishment of the sanctuaries—a sentiment which further manifests itself in organized efforts at implantations. For example, the editor of Forest & Stream[31] writes:

"Another implantation of 15,000 wild Rabbits from the West to repopulate New Jersey gunning ground, has been planned by the State Fish and Game Commission. . . . Results of the introduction of 10,000 Kansas Cottontails last year have delighted sportsmen, who report there is prospect of game increases in practically every county."

It is well to remember, however, that scientific naturalists disapprove of species from wholly different regions being introduced. They consider that the only truly biological plan is to preserve and foster the native species.

THE BUNNY BILLIONS

Of all the animals that we to-day call "game," the Cottontail is the most numerous. Even in middle New York State, they abound; here Bachman tells of taking 12 in a morning.[32]

---

[31] Dec., 1924, p. 768.

[32] Q. N. A., I, p. 178.

The State Game Reports give a fairly accurate minimum of the number killed. Game Warden Bryan, of East Baton Rouge Parish, La., reports the following game killed during 1908 in his territory: Wildcats, 55; Rabbits, 10,000; Mink, 960; doves, 15,000; Squirrels, 5,000.[33]

Frank C. Pellett writes: "Three hunters killed 60 Cottontails in one favourable afternoon on 100 acres of land about my home [Atlantic, Iowa]; and continued the slaughter intermittently for weeks, getting as high as 30 in a day, on other occasions. Even then, there was no apparent diminution in the number of the little animals about. Although not always as abundant as the winter above mentioned, they are always very numerous; and the guns and Dogs do not seem to check them as effectively as the disappearing predaceous birds and mammals have done in the past."[34]

E. E. Pierson, of Bloomingdale, Ill., credits 2 local hunters with having killed and marketed 1,400 Rabbits in the 6 months ending April 30, 1912.[35]

Interesting information from North Carolina is furnished by Fred A. Olds, of Raleigh, N. C. The great dam on the Yadkin River, 88 miles from Raleigh, was complete and closed. The water began to rise rapidly behind it. Islands formed, and the Rabbits that were drowned out, gathered on these; on one of them a party killed 72 Rabbits in a quarter of an hour. Similar bags were made on other islands.[36]

North Carolina seems to be particularly suitable for Rabbits. H. H. Brimley writes:[37] "For the past two months, we have published each week the number of Rabbits shipped from Siler City [Chatham Co.]; and now that the season has closed, it may be interesting to note that a compilation of these figures shows that the total number shipped this winter amounts to 18,059. And it must be borne in mind that these figures apply only to Siler City, whereas there are three other shipping points in western Chatham.

"The number shipped this year is unusually large, considering that there was no snow. A comparison for the last 5 years shows the following:

1910	19,671
1911	16,573
1912 (the year of unusual snowfall)	26,060
1913	13,979
1914	18,059

---

[33] Forest & Stream, July 10, 1909, p. 56.

[34] The Cottontail, p. 291.

[35] Forest & Stream, May 11, 1912, p. 595.

[36] As above, Feb. 3, 1912, p. 142.

[37] As above, Feb. 28, 1914, p. 273.

"From the above, it is seen that the shipments are larger every other year. . . . And, in spite of the great number of Rabbits killed annually, the stock seems to keep up."

In New York State, 465,590 Cottontails were taken in 1918.[38]

The relative abundance of Squirrels and Cottontails is shown in the annual official report of game killed in Pennsylvania for 1921. It stood: Squirrels, 63,120; Cottontails, 440,446.

In Pennsylvania, according to the official count, 2,719,879 Rabbits, practically all Cottontails, were killed in 1919; and in 1924, thanks to good game laws, 4,160,000 were taken without seriously depleting the stock.

In Virginia, 293,625 Cottontails were killed during 1920 (T. S. Palmer, Game as a National Resource, 1922, Bull. 1049, U. S. Dept. Agri., p. 6).

Finally, by way of summary, fully 25,000,000 wild Rabbits—mostly Cottontails—are killed in the United States every year, according to estimates made by the U. S. Biological Survey.[39] The *Conservationist*[40] puts it much higher, maintaining that 200,000,000 wild Rabbits are killed each year in the United States.

Now, it is well known that many more are killed by hunters than are reported, for no report is made on those illegally killed—that is, out of season. And no account is taken of the millions that are devoured by natural enemies. The last is certainly the largest toll the Cottontails must suffer, for these enemies are legion, they are pursuing and murdering, night and day, old and young, the whole year round. So that, I am convinced that a legal killing of 25,000,000 represents an actual killing of 100,000,000 Cottontails per annum.

It is established that no wild animal can stand a heavier drain than 20 per cent. per annum of its total numbers. The Cottontail is increasing under present conditions; therefore, if these figures be right, there must be alive in the United States to-day not less than 500,000,000 Cottontail Rabbits; for which comforting thought I am devoutly thankful amid a dreary record of carnage and extermination.

Form and Burrow

Each individual has not only a home range, but a number of forms or sheltered beds which it uses in turn, varied by wind and weather, for the forms face different ways.

---

[38] Bull. Am. Game Prot. Assn., Vol. VII, No. 4, pp. 11–14, Oct., 1918.

[39] As above.

[40] Nov., 1918, p. 176.

A form is nothing but a dry, well hidden nook with two ways from it—back and front. Usually it has a sort of roof, that is, enough to turn most of the rain. Those of us who want to be of help, have been putting sections of drain tile in the woods to give the Rabbits a ready-made ideal shelter.

Kennicott says that, in Illinois, the form "is in some concealed position, by the side of a log, in a small brush heap, or at the root of a bunch of briers and weeds, if in the woods; or it is frequently situated in the grass at the edge of the prairie, or of the sloughs that run into groves and outskirts of the woods; and here, as well as on the prairie, it is where the overhanging grass shelters and conceals it."[41]

The Cottontail will enter the deserted burrow of Woodchuck, Skunk, Fox, or Badger, under stress of danger or weather, but does not dig burrows for itself as does the English Rabbit.

Kennicott, the minute and careful, remarks, however: "I am credibly informed of a few instances in which they have been known to dig holes for themselves in hillsides; but these may be considered as departures from their natural habits."[42]

If we take advantage of snowtime, and are minutely observant, we shall find that each Cottontail has three or four forms or beds; and that these are joined by a few main trails which she ordinarily follows in going from one to the other. These trails are not very visible to us—we see them from too high a point—but to Molly, they are clear, open pathways, smooth, well labelled, and leading direct from one desirable place to another. One of them leads to some impregnable Cottontail castle, in case she has to baffle a Dog or Fox; and one always leads to the nearest garden. Molly always knows where she is going.

There is a well-worn path from the woods to my garden. I have seen her use it again and again. Indeed, I see her there each warm evening after sundown. But I have not stopped the path, or set a trap on it.

One day, I saw her enter by an open gate. I closed the gate and shouted. Molly ran straight for an opening in the wire fence at a point 3 feet up. She leaped for that, but failed to make it; so without a moment's hesitation or doubt, she steamed across to another point 200 feet away, and leaped up and through a hole in the wire at a place about 2 feet from the ground. A woven-wire fence has not many landmarks to hold the memory; but the precision with which Molly made for each of the two available holes, suggests that she had not only memory, but eyesight of the best description.

How small a hole a Rabbit can see or use is illustrated by the fact that

---

[41] Quads. Ill., p. 78

[42] As above.

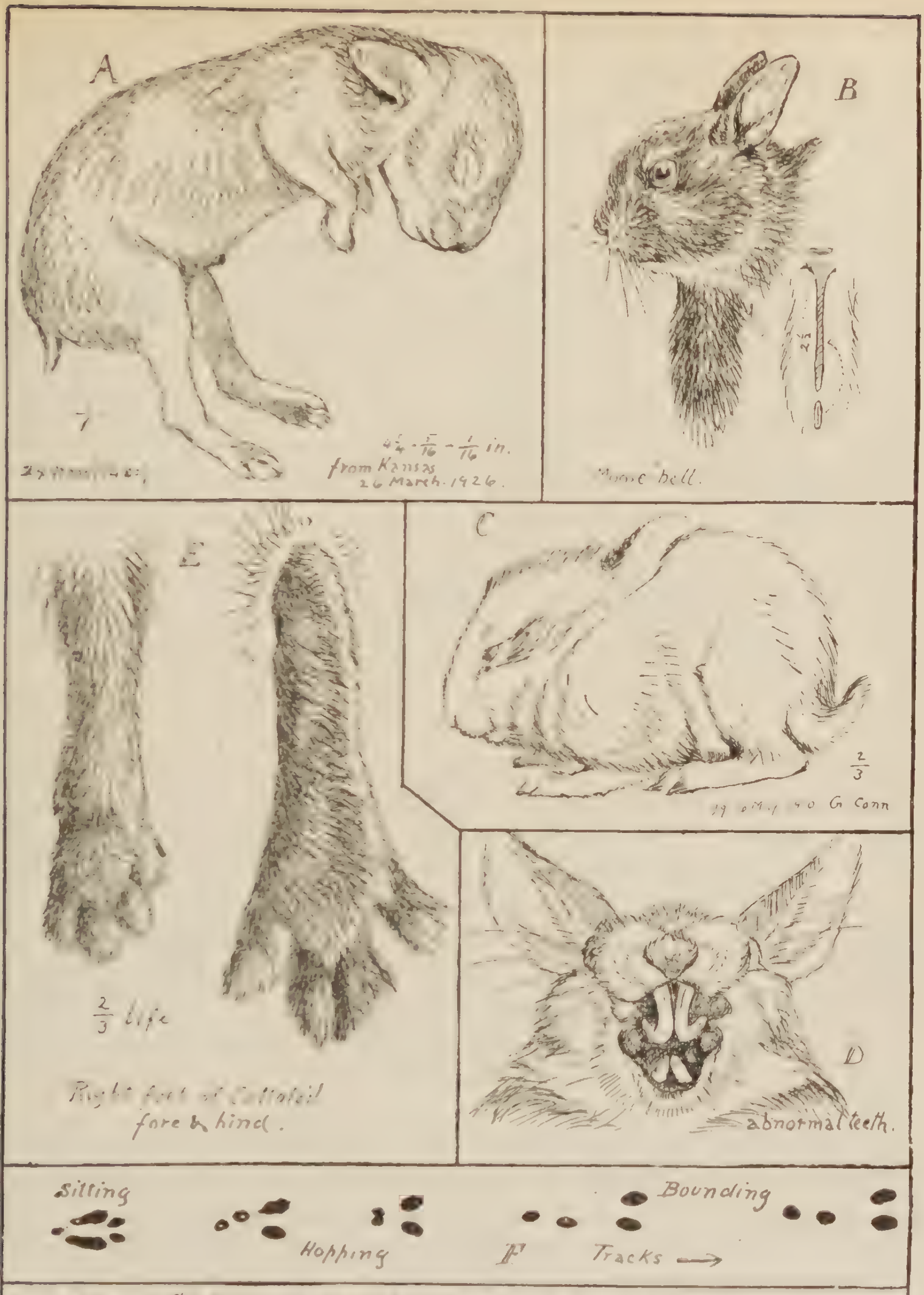


Plate CV Details of Cottontail: A newborn young;
B. Cottontail with Moose bell; coll.ⁿ of Jas H Fleming. C. yg. 10 days old
D. Abnormally grown teeth. Collⁿ Dr G. T. Runcies. Ind: E. right hind and
fore paws; F. Cottontail tracks.

one of my Cottontails leaped with scarcely a pause through a mesh wire opening that was barely $3\frac{1}{2}$ by $2\frac{3}{8}$ inches.

WINTER DENS

In cold winter, the Cottontail is seldom found in a form or bed, unless it be very well sheltered. She much prefers a hole under a stone pile, a hollow log or tree, at such times. She uses these for more than mere snoozing places, as we shall see. Indeed, she would not be true to rodent tradition if she did not at some time assume the deathlike torpor that may be called a "cold sleep." A driving storm sets in. Molly is ensconced under a thicket of briers and fern in one of her best forms, one most nearly weatherproof. The snow heaps up, shutting her into a sort of crystal-white cavern. Deeper and deeper piles the snow. Then the temperature falls, so that, though protected, she is numbed into a sort of frozen sleep. The raging of the storm outside kills every desire to venture forth. So long as the blizzard lasts, she rests, cold but not unhappy; a little hungry, perhaps, but not frozen—only drowsy—so drowsy that the easiest thing is to "lay low" and wait for better days.

TEMPER

Frank C. Pellett says:[43] "Although extremely timid, and offering no defence to an attack by other animals, they fight desperately among themselves, at least, in captivity. At present, we have a number of adults confined in wire pens, that were captured in box-traps. Now and then, an individual is very ugly with its fellows, and insists on tearing their fur and chewing their ears. A number have been killed in these scrimmages, and one with both ears chewed off still lives. A short time ago, we caught in a box-trap a specimen of the Nebraska Cottontail (*S. f. similis*), with holes in both ears. While this indicated a similar fight in the open, it is, of course, possible that these may have resulted from other causes than Rabbits' teeth."

Whether this berserker rage is peculiar to individuals or is an accompaniment of the mating season, I do not know. Kennicott formed a very different opinion of the Cottontail's combativeness. He says: "This Rabbit is not pugnacious, several even taking refuge in the same hole; but, though they exist in astonishing abundance in particular localities, they are not naturally gregarious."[44]

---

[43] The Cottontail, p. 291.

[44] Quads. Ill., p. 78.

TAMABILITY

It is a curious fact in the history of wild things that many of the wildest become most completely tame when properly managed; and many of those that, in their native state, are half-tame, can never be made domesticated or docile. Thus, the superferal Elephant, Wild Horse, Wild Dog, Wild-cat, Mink, Antelope, falcon, wild duck, respond completely when taken young, become members of the family. But the half-tame Fox, Hyena, pheasant, Canada jay, wood duck, and Cottontail, have never yet been tamed. They may be taken young and brought up so they tolerate our dwellings and our company, but never do they become truly members of the household—that is, domesticated—never do they learn to come at call, and rejoice in our company; never do they elect to stay with us when given the choice of returning to their wildwood kindred.

Good old Bachman, the father of loving natural history in America, wrote as far back as the '40's: "The Gray Rabbit, although it breeds freely in enclosed warrens, seldom becomes tame, and will probably never be domesticated. When captive, it seems to be constantly engaged in trying to find some means of escape, and though it digs no burrows in a state of nature, yet, when confined, it is capable of digging to the depth of a foot or more under a wall, in order to effect its object.

"We, however, at the house of Dr. De Benneville, at Milestown, near Philadelphia, saw 5 or 6 that were taken from the nest when very young, brought up by hand, so completely tamed that they came at the call, and leapt on to the lap of their feeder; they lived sociably and without restraint in the yard, among the Dogs and poultry. The former, although accustomed to chase the wild Rabbit, never molesting those which had, in this manner, grown up with them, and now made a part of the motley tenants of the poultry yard."[45]

MATING, BEARING, AND NEST

There is little evidence on record regarding the mating habits of the Cottontail. What there is, direct and collateral, indicates that the species is very loose in such matters.

It is quite likely that a new mate for each mating time is the rule; and there are three or even four mating times each year.

On Jan. 22, 1923, near Tucson, Ariz., I found Cottontail males in early rut. On April 10th, at Victorville, Calif., I found male Cottontails in full rut; and a female with embryos as large as an acorn.

---

[45] Q. N. A., I, p. 176.

C. S. Brimley, of Raleigh, N. C., says: "Four very small embryos taken from a female March 11, 1901; 5 embryos from another on June 5, 1901. Four young (167–215 mm.) taken July 4, 1892, and 2 more two days later."[46]

Analogy indicates that gestation lasts about 30 days, but there is no definite direct evidence at hand.

The nest in which the young are nursed is a slight hollow, usually out in an open field or meadow, preferably on a borderland —never in dense woods, always where the sun strikes. I have seen it in long grass near the woods, in a bank by the road, in the grass alongside an avenue, out in an open field, and in a garden among the strawberry plants.

The scratching-out of the hole is done by the mother—the father has no part in it whatever; and it is usually about 5 inches deep, 7 inches long, and 5 inches wide. It is beautifully lined with grass roots, and a little of the mother's down, plucked bravely and painfully from her own breast with her own sharp teeth. Over the home nest, is always a wad of down and grass, a sort of dummy mother, which covers the little ones like a counterpane when mother is away, and hides them from enemies as well as keeps them warm.

The Cottontail's nest is far harder to find than that of most ground-birds. Its concealment is so nearly perfect that it is rarely found except by accident.

The Young and Their Care

The young are in number from 4 to 6 or 7, very rarely as many as 8, or as few as 3. In Carolina, Bachman says that they are born "as early as the 20th of February, and as late as the middle of October, and in all the intermediate months."[47] He goes on to say that there are three broods in a season.[48] Kennicott says "three or four times a year."[49]

When born, the young Cottontails are tiny squirming mites of pink flesh, little bigger than one's thumb. And, notwithstanding the statements of one or two ancient and honourable naturalists, they are born blind, helpless and nearly naked. In this, they contrast sharply with the Hares, which come into the world with eyes open, furry coats, legs and senses active, strongly developed.

A young one born of a Kansas specimen, Mar. 26, 1926, weighed 24 grams, that is, about $\frac{3}{4}$ oz. It measured $4\frac{1}{4}$ inches long, tail, $\frac{5}{16}$ inch, hind foot, $\frac{11}{16}$ inch. It was everywhere covered with very fine, short fuzz, but had no hint of the adult colour pattern, except in having a white blaze on the forehead. A drawing of this specimen appears in Plate CV (p. 805).

---

[46] Journ. Mamm., Nov., 1923, p. 263.

[47] Q. N. A., I, p. 176.

[48] As above.

[49] Quads. Ill., p. 81.

Since the matter has been much discussed, I give the details of Cottontail nests that I observed:

Greenwich, Conn., May 8, 1920. Found 4 young Cottontails in nest near potato field. Took photo (May 10th) of nest and young Cottontail.

May, 12, 1921. Found a Cottontail's nest torn open. As no dead young lay about, it was probably the work of a Fox.

June 2. Found a Cottontail's nest on the drive, made, as usual, of dry grass lined with mother wool. It held 4 young, blind and helpless, but well-haired, maybe 10 days old. They kept jumping up vigorously when touched. I think they were hungry. This was before sundown.

June 4. After sundown, went to the Cottontail's nest. The mother sat near by, but soon ran away. I squeaked in vain; she would not come back, although two song-sparrows were much moved. The young were wholly covered up, and I think fully fed, as they lay very still when I touched them.

June 6. Went to the Cottontail's nest about an hour after sundown. The young were well covered and evidently well fed, for their little bellies were distended, and they were very logy. The eyes were not yet open of the one I took out, nor could I open them. I saw no sign of the mother near.

June 7. After sundown, I went to the nest. One young one had its eyes closed, one had them open. They were evidently hungry, but I saw no mother about.

Since European Rabbits' eyes are opened the 11th day, this would argue that they are about 10 days old, therefore born about May 27th.

June 8. 8 A. M. All the young Cottontails had their eyes open. At one hour before sunset, all were gone, a part of the nest lining lying 3 feet away. No Fox or Skunk would get them in the daytime. They might have been taken by a Dog, Cat, or crow; or possibly, they had simply scattered in their ordinary way.

On June 23, 1911, I found a Cottontail's nest in the grass at Cos Cob, Conn., on my grounds. It contained 4 young. I think they were less than a week old. Their eyes were closed, their ears were very short, but they had a coat of close, fine fur. Their growth the next three days was very rapid. On the third day, I went to the place, and saw a huge black Cat standing over it. The nest was empty. No doubt, the little Rabbits went the way of the canary. The mother must have visited them every night, for they were thriving. But she certainly did not once come in the daytime, as some of us were near by the whole time.

William's Bay, Lake Geneva, Wis., Friday, July 24, 1914. A Cottontail nest was found in the grass by the road just in front of my cottage yesterday. All the young (6) had their eyes closed. Sunday, all were open but 2. On July 20th, 4 only remained in the nest; all were big and strong. The mother came by night only. All were gone on Friday noon, July 31st. Therefore, they were in the nest 10 days or 2 weeks at most. (Plate CIV, p.798.)

J. D. Mitchell, of Victoria, Tex., after keeping and raising many broods of Cottontails in captivity, says: "When suckling her young, the mother Rabbit does not scratch away the weed and grass covering to the nest; but skilfully raises it and gets under it, curling herself around the outside of the nest, and cuddling her young to the centre, keeping the cover intact, and everything hid. I have had them remain quiet, and continue suckling their young when I lifted the straw covering to the nest."[50]

In Aug., 1910, at West Salem, Wis., the summer home of Hamlin Garland, I was shown a Cottontail nest in the garden among the strawberry plants. It was found by the children on Aug. 1st. It was a hole in the ground, 5 inches deep, 7 long, and 6 wide, beautifully lined with grass roots and a little of the mother's down. It contained 6 young, apparently nearly two weeks old, well-furred and active, but blind; one of them, a runt much smaller than the others, the family feebling.

That night, Garland watched until dark, but saw no sign of the mother. He laid some wet strawberry leaves on the coverlet; in the morning, these had been removed, showing that the mother had visited them in the night, completely covering them as before, but with other material.

All next day, they were watched by workers in the garden until dusk; and again we were sure that the mother did not visit them during the hours of light. Nor was she ever seen in the garden but twice—once in the early morning, and once after sundown.

On Aug. 5th, some of them had their eyes open; on the 6th, the rest also could see. When taken out of the nest at this time, they at once scrambled back again, and snuggled in, filling the hole completely. On the 7th, all had gone from the nest. One of them, found in the garden, was apparently able to take care of itself, though so small. When I lifted it, it squealed lustily, but the mother did not appear.

Up to that moment, none of them had uttered any sound, in spite of much handling by the children. On the only occasion when I saw the mother, I squeaked, but it did not seem to interest her; perhaps my squeak was poor.

The sum of testimony makes it certain that the mother visited them

---

[50] Nelson, Rabbits, pp. 14–15.

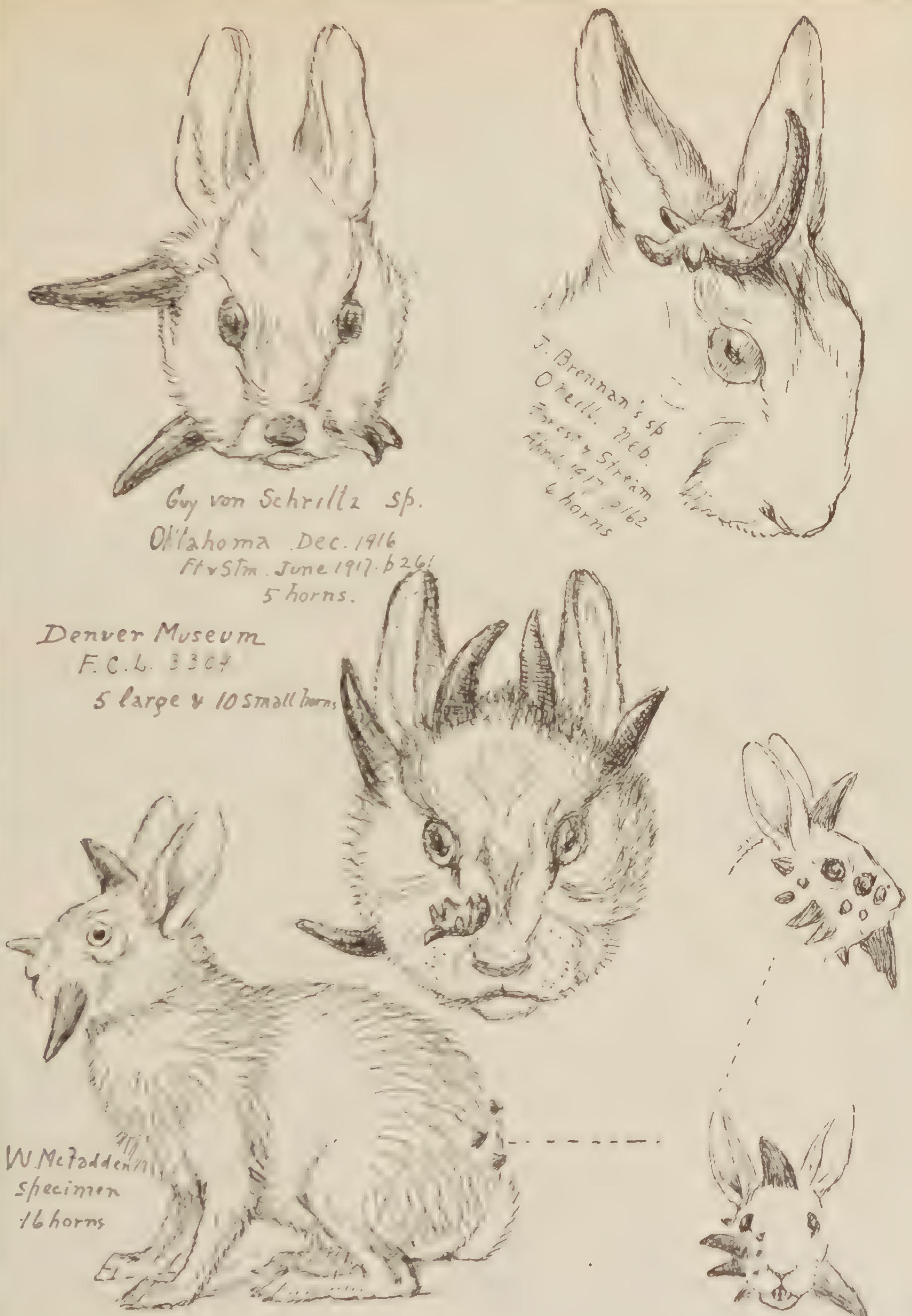


Plate CVI Horned Cottontails E.T. Seton

only at night; and the little ones seemed so lively that this is probably the normal habit of the species.

She may suckle them individually when she meets them during the few days following the dispersal; but there is no evidence to show that she ever gathers them together, or cares for them as a brood, after once they have left the nest.

After Leaving the Nest

The growth of the young Cottontails is very rapid, quite in line with their quick development in the nest. When barely two weeks old, and no bigger than a baby's fist, they may be seen running hither and thither through the woods, quite disbanded so far as nursery life is concerned. But there is evidence that they are still under mother's care. In a month, however, they are quite independent of her.

"I have caught the young ones in the grass," says Frank C. Pellett, "and have been surprised at the response of the mother to their cry. She came instantly, but her timidity overcame her anxiety, so that she ran away again."[51]

An interesting play-game between Squirrels and a Cottontail of this age, is reported to me by Miss E. A. Robinson, of Eaton's Neck, Northport, Long Island, N. Y. A brood of Gray-squirrels was raised in a tree at the end of their garden; and every evening between July 10th and 16th of 1923, the 4 young Gray-squirrels were met by a young Cottontail Rabbit that romped and played tag with them.

Brave Molly Cottontail

Molly, in a more stirring rôle, is thus portrayed by Kennicott. "It is pleasant," he says, "to observe that an animal usually so timid and unresisting, will fight bravely for its young. A naturalist tells me that he once saw a Gray Rabbit attack a large black snake, which was holding one of her young in its coils. She fought by springing over the snake, and striking back with her hind feet, which is the usual mode of defence of this species. Her blows were delivered with force and precision, and so rapidly that the snake was struck nearly every time; despite his attempts to evade them. As she passed, the snake aimed at her with his fangs; but, though he often scratched off a mouthful of hair, he was plainly getting the worst of the battle, when the naturalist interfered."[52]

---

[51] The Cottontail, p. 291.

[52] Quads. Ill., p. 81.

Another instance is related in which a Rabbit was observed to pursue a hawk in the act of carrying off her young.[53]

The following incident, witnessed by three reputable citizens, is doubtless closely similar in its cause, etc. "During the last open season (August) for doves in this State," says H. Fields Saumenig, Rector of St. Peter's Church, Rome, Ga., "while driving in an automobile one afternoon toward a distant hunting ground, we were surprised to see a large black snake cross the road ahead of our car. The snake, fully 5 feet long, was travelling at a rapid rate, and was pursued by a Rabbit; the Rabbit all the while biting at the snake's tail, and attempting to put up a fight. When the snake disappeared in the brush on the other side of the road, the Rabbit gave up the pursuit, and recrossed the road, and was lost in the undergrowth.

"The only explanation that occurred to those of us who watched this strange performance, was that the snake had attacked the Rabbit's young, and the Rabbit was acting with the natural instinct of the mother in protecting her offspring. Two things are quite certain—the snake was plainly being beaten, and the Rabbit was putting up a fight."[54]

A like motive may have been back of the following incident, related to me by the famous archer, Will H. Thompson, of Seattle, Wash. About 50 years ago, his father, the Rev. Griggs H. Thompson, was travelling through a wooded part of Missouri, when he heard a loud "*qua-a-a qua-a-a qua-a-a*," like the cry of some little animal in pain. He peered through the bushes, and saw a Cottontail Rabbit leaping over the body of a Skunk, striking it with its hind feet, and uttering the squealing he had heard. The Skunk was dead, but evidently killed within a few minutes. Its skull was broken. It seemed impossible that the Rabbit should have done it, but there was nothing to show who else did, or why the Rabbit should be fighting the body.

A PRIVATE LETTER

Greenwich, Conn.,
Jan. 23, 1927.

To MRS. MOLLY COTTONTAIL,
The Brier Patch,
Wild State, U. S. A.

DEAR MOLLY:

I have just finished writing a long account of you for the children of America. I have tried to be very true and restrained, because I know that the children will show the chapter to their teachers, and it will come before the stern critics of the Biological Survey. But there is no use trying to hide from those men the fact that I am your friend.

---

[53] Quads. Ill., p. 81.

[54] Field & Stream, Dec., 1919, p. 798.

Dear little Molly, I love you. And I wish I could, in honesty, exalt you to a high place in the world of intellect. Alas, I fear I cannot. You are but a sweet, dull-witted wild thing. You can scarcely be tamed, and cannot be taught at all. You have nothing but a Rabbit wit at best; and all attempts to domesticate and educate you, have scarcely robbed you of an insane and energetic desire to get away and hide.

"Harmless as a Rabbit" is an old adage; and, of all the soft, pretty things that roam our woods, you, Molly, most nearly live a blameless life. I would like to hold you above all reproach, but we cannot ignore the testimony of many naturalists—good friends of yours, like John Bachman, and his following. They maintain or admit, that you do at times destroy young orchards. Destroy orchards! Pah! I have looked fully into the charges, Molly, and find that sometimes a few orchard trees are peeled on your home range. Yes, it is so. But, in nine cases out of ten, it was done by Mice.

They hold that you cut off orchard twigs as high as you can—far beyond Mouse reach. Sometimes, no doubt, you do. But who wants orchard twigs growing so low as two feet from the ground? Pretty poor gardeners, I call any who do.

The truck farmers in Pennsylvania charge you with ruining their cabbage patches. The calamity-howlers! You took maybe one or two cabbages. Why don't they fence their cabbages, if they are so precious? Cows will eat cabbages; but is that a reason to go and shoot all the Cows?

They say that, if not you, at least your husband with your approval, has often broken out into a quarrelsome rage, and even murdered some neighbour whose ways were not to his liking. To this, I reply, first, it was not proven; and second, we are not discussing your husband.

They say that your intelligence never soared above tricks to save yourself or your children from hawk or hound. Well, what of it? To what better use could your wits be put? Show me a stronger guarantee of your right to live.

I have held against selfish men that, unlike most wildwood things, you care nothing for fruits or berries. You dig no holes to menace Horses' legs or water-dams. You have no evil habits that can be a curse to other dwellers on your range. Your orchard toll is trifling. You have never bitten nor scared a child; you have never even worried a Sheep. And certainly, you never robbed a bird's nest in all your life.

In short, dear Molly, every charge, trumped up or founded, has been proven false or silly. We have defeated the enemy. The children are with me in proclaiming yours to be a blameless life. They shouted for joy when they heard how you made a fool of that big Dog that was trying to kill you. And, more than that, Molly, we all love you for your courage; the brave way in which you defended your baby from the black snake made for you millions of friends. It was noble—heroic. We are all for you—that is, we young folks.

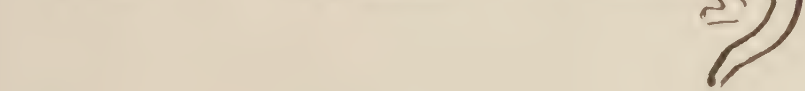
You have won, and will ever hold a foremost place in our fields, our stories, and our affections—that is, as long as America has children to show the parents the better way. And if ever the time come that I cannot see you at sundown, near my house, I shall feel that the woods has lost one of the pleasantest things it has held for me, a daily joy I had learned to count on.

Your devoted admirer,
The Author.

P. S. If I can do more, drop me a hint.

References

1849—Quadrupeds of North America, by Audubon and Bachman, I, pp. 173–88.
1858—Quadrupeds of Illinois, by Robert Kennicott, pp. 77–84.
1907—The Rabbit as a Farm and Orchard Pest, by David E. Lantz, Yearbook Dept. Agri., pp. 329–42.
1909—Rabbits of North America, by E. W. Nelson, N. A. F. 29, pp. 159–98.
1911—The Cottontail, by Frank C. Pellett, *Forest & Stream*, Feb. 25, p. 291.



LIFE XCIX—BRUSH RABBIT

PAGE
Names 818
Description: Size, Colour 818
Races 818
History 819
Range 819
Habits 820

References 820

RABBIT MULTIPLYING

Brush Rabbit of California, Bachman's Cottontail, Brush Bunny

Sylvilagus bachmani (Waterhouse)

(*Sylvilagus*, see *ante; bachmani*, in honour of the Rev. John Bachman, D. D.)

Lepus bachmani Waterhouse, 1838, Proc. Zool. Soc. London, VI, p. 103.
Sylvilagus bachmani Lyon, 1904, Smiths. Misc. Coll., XLV, p. 336, June 15.

Type Locality—California; on the coast south of Monterey, probably near San Luis Obispo

The Wasco Indians call it *Za-lak*.[1]

A ♀ specimen from Portola, Santa Cruz, Calif., taken March 24, 1895 (Am. Mus., No. 10718), is as follows:

Size. Total length, 13$\frac{3}{8}$ in. (340 mm.); tail, 1$\frac{1}{2}$ in. (38 mm.); hind foot, 3$\frac{1}{8}$ in. (79 mm.); ear, 2$\frac{1}{16}$ in. (52 mm.).

Colour. At first glimpse, it is, in colour, simply a huge Meadowmouse with a bob-tail and a yellow-brown nape. Compared with a typical Cottontail from Florida, it is much darker and less reddish; that is, it is olive in effect, very much peppered and with the Cottontail pattern traceable, but very dim; even the hip-patch is represented. Its underparts are dull grayish white, stained buffy at the edges—nowhere pure white; and much modified by the lead colour of the under-fur showing through, as in *Microtus*. The tail is short; above it is of the general back colour, thickly peppered; below, white or yellowish white.

It is, in brief, a small Cottontail with short legs, tail, and ears; and, in general, of an olive or brownish gray, nowhere pure white, except the underside of the tail.

Races

The following forms have been recognized:

bachmani Waterhouse, the typical form. T. l., California.

ubericolor Miller, a little larger than *bachmani;* ears smaller; upper parts darker and more reddish; skull, much heavier, with smaller bullæ. T. l., Beaverton, Washington Co., Ore.

---

[1] J. K. Lord, Naturalist in Br. Col., 1866, II, p. 102.

cinerascens Allen, much like *bachmani;* but upper parts, lighter, grayish brown; underparts, grayer; tips of feet, whiter; and ears, larger; skull, smaller and lighter, with larger bullæ. T. l., San Fernando, Los Angeles Co., Calif.

exiguus Nelson, similar in size and form to *cinerascens*, but with much longer ears and larger bullæ; upper parts paler, with ground colour more pinkish buffy; nape, feet, and legs, paler; and a fairly well-marked rump patch. T. l., Yubay, Lower Calif.

peninsularis Allen, most like typical *cinerascens*, including length of ears, but head and upper parts paler and grayer; ears, paler, and more brownish. T. l., Santa Anita, Lower Calif.

cerrosensis Allen, upper parts, nearly uniform grayish brown, like typical *cinerascens*, but slightly darker, and more buffy; with tops of fore and hind feet distinctly buffy. T. l., Cerros Id., Lower Calif.

mansuetus Nelson, size of *cinerascens;* palest of all the members of this group; colour, much paler and grayer even than *exiguus;* ears long, equalling those of *exiguus*. T. l., San José Id., Lower Calif.

HISTORY

Back in the first part of the last century, there was a famous traveller and naturalist named David Douglas. His chosen region for exploration was the Pacific coast of America; and many new species were the result of his travels: the Douglas Squirrel, Douglas Gopher, Douglas Groundsquirrel, and Douglas fir, for example. In the chaparral thickets of the Californian coast, he collected the first specimen of this species known to science. He sent it to the British Museum, where the skin remains to this day. G. R. Waterhouse, the *Rodentia* expert, recognized it as new; and, in 1838, named it after the Rev. John Bachman, the naturalist who supplies the text to Audubon's plates in the "Quadrupeds of North America."

RANGE

This Rabbit has the longest, narrowest ribbon of a range of all the creatures whose Lives are herein set forth. It stretches from the Columbia River to the red-tip of Lower California—some 1,800 miles—yet is less than 100 miles wide.

HABITS

The Brush Rabbit seems different from the Cottontails of its region when viewed by the microscopically trained eye of the closet expert; but to the field-man and sportsman, their habits are much the same. Any differences that may be noted, arise from their choice of different haunts. In the dense thickets of low matted or thorny brush, they find the food and protection that they need. And there is little doubt that the remarks on the Cottontail's home life, signals, food, and enemies apply in a general way to those of its small brother, the Brush Rabbit.

REFERENCES

1909—The Rabbits of North America, by E. W. Nelson, *N. A. F.*, No. 29, pp. 245–57; 1 map.

LIFE C—THE SWAMP-RABBIT

PAGE
Names 822
Description: Size, Weight, Colour 822
Comparison of the Three Species 822
Races 823
Range and Haunts 823
Numbers, Tracks, and Food 824
Communication and Curious Habit 824
Mating, Nest, and Young 825
His Way of Life 825

References 827

Swamp-rabbit, Swamp-hare, Cane-cutter

Sylvilagus aquaticus (Bachman)

(*Sylvilagus*, see *ante;* L. *aquaticus*, aquatic, or, of the water)

Lepus aquaticus Bachman, 1837, Journ. Acad. Nat. Sci., Phila., VII, p. 319.
Sylvilagus aquaticus Nelson, 1909, *N. A. F.*, 29, p. 270, Aug. 31.

TYPE LOCALITY—Western Alabama

This is the biggest of the Cottontail group.

In addition to the generic characters, the Swamp-rabbit has:

Size. Total length, 21 in. (534 mm.); tail, 2¾ in. (69 mm.); hind foot, 4⅛ in. (106 mm.).

Weight. Bachman gives a female, 6 lbs.[1] Two males taken by myself near Austin, Tex., Nov. 6, 1920, weighed 4 lbs. 12 oz. each.

Colour. The Swamp-rabbit shows the basic Cottontail pattern; but dark, brownish, and much obscured. Its general colour is dark brown, coarsely peppered with black, almost splashed; all below, clear white, except on the chest which is pale brown. Legs, rump, upper tail, nape, and face, dull sienna brown; ears, without white.

Compared with *floridanus*, it is a bigger animal, darker, tinged all above with sienna, coarsely peppered with black. The grayness of *floridanus* is a strong feature; also *floridanus* has whitish hind feet, *aquaticus* brown.

Compared with *palustris*, it is bigger and not so dark, with all of its underparts white as in *floridanus*. Also, its tail is long, about 3 in.; whereas in *palustris*, it is about 1⅜ in. In *aquaticus*, the under-side of the tail is pure white.

COMPARISON OF THE THREE SPECIES

	Cottontail (*floridanus*)	*Water-rabbit* (*palustris*)	*Swamp-rabbit* (*aquaticus*)
Total length	17 in.	17 in.	22 in.
Tail	2 in.	1⅜ in.	3 in.
Weight	3 lbs.	3 lbs.	6 lbs.

---

[1] Q. N. A., I, p. 288.

	Cottontail (*floridanus*)	*Water-rabbit* (*palustris*)	*Swamp-rabbit* (*aquaticus*)
General colour	gray	dark brown	yellow-brown
Under-side of tail	white	gray	white
Breast	white	gray	white
Hind feet	white	gray	brown

"Its feet are thinly covered with hair, and its toes (which are capable of being widely spread), are well adapted to enable it to swim, and to pass over marshy and muddy places."[2]

RACES

The following forms have been recognized:

aquaticus Bachman, the typical form. T. l., Western Alabama.

littoralis Nelson, same size, but much darker and redder, especially on rump, hind legs, and tops of all the feet. T. l., Houma, Terrebonne Parish, La.

RANGE AND HAUNTS

This is a species of the low, wet Mississippi Valley from the west side of Georgia to mid-Texas, and north to southern Illinois and Missouri, meeting but not overlapping the range of its cousin, the Water-rabbit.

Though called *aquaticus*, this species seems less aquatic than *palustris*. It is sometimes found in dry bottom-lands exactly like those places selected by the Common Cottontail, but usually lives in moist river bottom woodland or cane-brakes. In the oak groves near Austin, Tex., where first I met it, it was abundant, and lived much the life of a Jackrabbit. Bachman says:

"Although the Swamp-hare is occasionally seen on high grounds in the dense forest, it prefers low and marshy places, or the neighbourhood of streams and ponds of water, to which it is fond of resorting. It swims with great facility from one little islet to another."[3]

And Kennicott: "It lives constantly near water, in low and swampy grounds, feeding chiefly upon paludal plants; and it not only takes to the water and swims readily, but even dives without hesitation when pursued. In Southern Illinois and Missouri, it is observed to prefer the densest forest as well as the vicinity of water, being rarely seen on the hills or in open woods. It abounds in the deep cypress swamps and dark heavily timbered 'bottoms' along the Mississippi."[4]

---

[2] Q. N. A., I, p. 290.

[3] As above, pp. 288–89.

NUMBERS, TRACKS, AND FOOD

We are told by several observers that this Rabbit is plentiful in the lower Mississippi Valley. What *plentiful* means, I do not know; but at Austin, Tex., where it is not plentiful, I saw a dozen in one morning's prowl. Almost the only definite information on its numbers is the following by Bachman:

"When the waters in the swamps are low, it seeks the first hollow tree, where it is easily secured. In this manner, Major [J. M.] Lee informed us, that in his vicinity the boys and the domestics caught 30 or 40 in 3 days."[5]

"The tracks of this species, and of the Marsh-hare, [*palustris*] in the mud, leave a distinct impression of the toes, whilst on the contrary, the tracks of the Gray Rabbit, the Northern Hare, and the Polar Hare, exhibit no such traces; their feet being so thickly clothed with long hair that even the points of the nails are scarcely perceptible."[6]

It "is generally found seeking its food in wet places, or near the water, as it subsists on the roots of various kinds of aquatic plants, especially on a species of iris growing in the water."[7]

COMMUNICATION AND CURIOUS HABIT

Probably all of the Cottontail group do their chief signalling by thumping with the hind feet; we have no observations to show that the Canecutter specializes in this department, but the following by Bachman is suggestive:

"Persons who have given us information on the subject of this Hare, inform us, that when first started, and whilst running, its trampings are louder, and can be heard at a greater distance, than those of any other Hare."[8]

In one habit, this Rabbit is said to be peculiar. It affects perches and high lookouts, much as do the Mountain Goats and sundry Squirrels. Thus,

---

[4] Quads. Ill., p. 86.

[5] Q. N. A., I, p. 289.

[6] As above, p. 290.

[7] As above, p. 289.

[8] As above, p. 289.

Kennicott says: "It generally rests upon logs, stones or other elevations, in preference to sitting in a form on the ground; a habit probably acquired from the necessity of choosing an elevated seat when inhabiting the swamps."[9]

Howell, on the other hand, considers this species like its cousins in its choice of form, and says: "I have started scores of the Rabbits, and *never* saw one anywhere but on the ground."[10]

Mating, Nest, and Young

Complete ignorance is the sum of our information on the mating of this Rabbit. But mating habits are usually alike in any given Family. This species is close kin of the Cottontail; and it has probably the same marriage customs.

Unlike the true Hares, it forms a nest. "The young of this Hare," says Bachman, "are frequently found in nests formed of leaves and grasses, placed on hillocks in the swamps, or in the hollow of some fallen tree."[11]

According to J. D. Mitchell, "the young of the Texas Swamp Rabbit (*Sylvilagus aquaticus*), are also born blind and naked."[12]

And the sage of Charleston rounds it out by adding: "We have been informed that it produces young at least twice in a season, and from 4 to 6 at a litter."[13]

His Way of Life

Dr. C. E. McDermott of LeRoy, O., contributes a colourful note on the way of the Swamp-rabbit.

"Three years ago," he says, "I spent 2 months in Alabama, on the Warrior River, and while there killed a few Rabbits of a kind new to me. The natives called them Water-rabbits. They are the colour of the common Gray-rabbit, and as large, or nearly so, as the Jackrabbit. All I found were sitting near the water, along the river. One sat in water, perhaps an inch deep, but with good cover about him.

"One day, while drifting with the current, watching for game ahead and along the banks, I saw something swimming in front of us. My partner said it was an Otter, and so I thought. As it passed out of sight around the bend, we put to shore and I got out and ran across and below where we saw it last. Coming cautiously to the bank, I saw the wake of something just below me, and still thinking it an Otter, I raised my gun and kept a sharp lookout.

---

[9] Quads. Ill., p. 86.

[10] Personal letter.

[11] Q. N. A., I, p. 289.

[12] Nelson's Rabbits, p. 15.

[13] Q. N. A., I, p. 289.

"Soon I saw something move, in a bunch of floating weeds, and so did a passing hawk. The bird swooped, missed its quarry and, seeing me as it rose, sailed away. Then the animal in the water moved again and I fired.

"You can imagine my surprise on drawing from the water, a Rabbit as large as two of the common Cottontails."[14]

But such observers and recorders are few and scattered.

When gathering and shaping the meagre facts that show us his way of life, one is struck by his resemblance to a small Deer. His habitual feeding grounds are not in wet places, but rather in dry thickets near water. So the name *aquaticus* is unfortunate, for this animal is less of a water creature than his cousin, the *palustris*.

When the Cane-cutter is startled by the hunter, away he goes with high noisy bounds, displaying his white banneret, stamping on the hard ground with loud thumpings, to rise again, bounce away into friendly cover; and, if pursued by Dogs so swift, so tireless that he needs must hide, he again lives up to the Deer tradition by making for the water, where his scent may be lost, and himself escape by hiding.

Bachman was impressed with this resemblance, and wrote in the '40's: "As it suddenly leaps or bounds from its hiding place ere it is seen, it is apt to startle the rambler who has intruded upon its solitary retreat; and he may be impressed with the belief that he has started a young Deer. When chased by Dogs, the Swamp-hare runs with great swiftness, and is able to escape from them without difficulty; but it almost invariably directs its flight towards the nearest pond, as if led by instinct to seek an element in which all traces of its scent are soon lost to its eager pursuers. . . .

"Whilst the Gray Rabbit strenuously avoids water, the present species plunges fearlessly into it, and finds it a congenial element."[15]

"There is a specimen of the Swamp-hare, which we added to the collection of the Academy of Natural Sciences, Philadelphia, considerably larger than the Northern Hare; this individual, on being pursued by hounds, swam twice across the Alabama River, and was not captured till it had finally retreated to a hollow tree.

"We have been informed that it is a very common habit of this species when pursued, to swim to the edge of some stream or pond, retreat beneath the overhanging roots of the trees that may be growing on its border, or seek for a secure shelter under the hollows made by the washing of the banks. The swiftness of foot possessed by this Hare, and the stratagems to which it is capable of resorting, might easily enable it to elude pursuit, but for this habit of seeking for shelter as soon as it is chased, which is the cause of its being frequently captured."[16]

---

[14] Recreation, July, 1898, p. 58.

[15] Q. N. A., I, pp. 289 and 291.

Especially is this so, when, as often happens, it makes the mistake of hiding in a hollow tree. Here it is safe indeed from Dog or Fox, but the hunter, alas! has many new wiles; a hole made with an axe or the brutal twisting-stick is quickly used, and the Cane-cutter is added to the list of dead.

REFERENCES

1849—Quadrupeds of North America, by Audubon and Bachman, I, pp. 287-91.
1858—Quadrupeds of Illinois, by Robert Kennicott. Report of U. S. Comm. Patent, 1857, pp. 85-86.
1909—Rabbits of North America, by E. W. Nelson, *N. A. F.*, No. 29, pp. 14-15.
1921—Biological Survey of Alabama, by A. H. Howell, *N. A. F.*, 45, pp. 71-73.

---

[16] Q. N. A., I, p. 289.

LIFE CI—THE MARSH-RABBIT

PAGE

Names 830

Description: Size, Weight, Colour 830

Anatomy 830

Races 831

History 831

Range and Haunts 831

Numbers 832

Food 833

Enemies and Disease 833

Flesh and Track 834

Mating and Nest 834

Breeding and Young 834

Habits 835

Bathing 836

References 837

Marsh-rabbit, Water-rabbit, Pontoon-rabbit, Small Water-rabbit, Lesser Marsh-rabbit, Wet Rabbit, or Pontoon

Sylvilagus palustris (Bachman)

(*Sylvilagus*, see *ante;* L. *palustris*, of the marsh)

Lepus palustris BACHMAN, 1837, Journ. Acad. Nat. Sci., Phila., VII, p. 194.
Sylvilagus palustris NELSON, 1909, *N. A. F.*, 29, p. 266, Aug. 31.

TYPE LOCALITY—Eastern South Carolina

When seen alive, the Water-rabbit looks much like a Cottontail, without any cotton under its tail; and of dark brown colour, much peppered on the back with black. Furthermore, its ears are very short and broad; its hind feet narrow, and short-haired.

In addition to the generic characters, it has:

Size. Total length, about 17¼ in. (438 mm.); tail, 1⅜ in. (35 mm.); hind foot, 3⅝ in. (92 mm.); ear, from the notch in the dried skin, 2 in. (51 mm.).

Weight. 2½ lbs.[1]

Colour. The Cottontail pattern is barely visible. Compared with typical *floridanus*, this animal is much darker, and more rusty coloured; coarsely peppered on the back with black. It has no pure white anywhere except, occasionally, inside the hind legs. Even the under-side of the tail is more or less gray.

From *aquaticus*, *palustris* may be distinguished by its smaller size, and shorter ears; by its redder colour, gray belly, and shorter tail.

ANATOMY

"The feet of the Marsh-hare are admirably adapted to its aquatic habits. A thick covering of hair on its feet, like that on the soles of other species, would be inconvenient; they would not only be kept wet for a considerable length of time, but would retard the animal in swimming. Quadrupeds that frequent the water, such as the Beaver, Otter, Muskrat, Mink, etc., and aquatic birds, have nearly naked palms; and it is this peculiar structure, together with the power of spreading out its feet, and thus increasing the space between each of its toes, that enables this quadruped to swim with great ease and rapidity."[2]

---

[1] Q. N. A., I, p. 152.

RACES

The following forms have been recognized:

palustris Bachman, the typical form. T. l., eastern South Carolina.

paludicola Miller and Bangs, the smallest, darkest, and most reddish-brown of the Pontoon-rabbits; ears, very short, broad, and round. T. l., Fort Island, near Crystal River, Citrus Co., Fla.

HISTORY

Bachman writes: "As a remarkable instance of a species continuing to exist in a thickly settled country without having found its way into scientific works, we may refer to this very common species. We obtained specimens in Carolina in the spring of 1815. It was called by the inhabitants by the name of Swamp, and Marsh Hare, and generally supposed to be only a variety of the Gray-rabbit. We did not publish a description of the species until 1836. In the following year, Gray, who had not then seen the Transactions of the Academy of Natural Sciences of Philadelphia, in which our description was contained, described it under the name of *Lepus Douglassii*."[3]

Lepus douglassii Gray, is now, of course, relegated to the limbo of dead-weight synonymy, and Bachman's name stands. Moreover, this sad statement may be made without fear of contradiction: no one since Bachman, the father of animal-history in America, the Izaak Walton of our Quadrupeds, has written anything new of importance on this interesting creature's habits. Kennicott, the careful and minute, offers nothing but what is obviously taken from Bachman. Beyond some casual glimpses in Florida, I never met the creature myself; and this attempt at its life history is little more than a rearrangement of Bachman's 1849 account.

RANGE AND HAUNTS

Its range is, as shown on Map XVIII (p. 684), the swamp-lands of the low region along the coast from the Dismal Swamp of Virginia south and west to Alabama, and including Florida.

The chosen haunts of the Marsh-rabbit are the low and, more or less, wet places that lie between the haunts of the Cottontail and those of the Muskrat.

---

[2] Q. N. A., I, pp. 153–54.

[3] As above, p. 156.

"In high grounds, it is never seen," says Bachman,[4] and it "is generally found in low marshy grounds that are sometimes partially inundated, near rivers subject to freshets that occasionally overflow their banks, or near the large ponds called in Carolina 'reserves,' which are dammed up or otherwise made to retain the water intended to flood the rice-fields at the proper season.

"In these situations—to which few persons like to resort on account of the muddy nature of the ground, and the many thorny and entangling vines and other obstructions that abound near them; and which, besides, continually exhale from their stagnant waters a noxious vapour, which gradually generates disease—surrounded by frogs, water-snakes and alligators, this species resides throughout the year; rarely molested by man, and enabled by its aquatic habits, to make up for any want of speed when eluding the pursuit of its enemies.

"It winds with great facility through miry pools, and marshes overgrown with rank weeds and willow bushes; and is quite at its ease and at home in the most boggy and unsafe parts of the swamps.

"We have met with this animal a few miles from Columbia, South Carolina, 120 miles north of Charleston, along the muddy shores of the sluggish rivers and marshes; but on arriving at the high grounds beyond the middle country, where the marshes disappear, it is no longer to be found."[5]

Thus, to sum it up, we see that this *palustris* is the most aquatic of the Rabbits, far more so than the species misnamed *aquaticus*. For this lives by choice wholly in and about the water; the other seeks it only in emergencies—is, in fact, only a semi-occasional aquatic. The three may be arrayed as Cottontail, dry; Cane-cutter, damp; Pontoon, wet. It is most unfortunate that the damp one should be called *aquaticus*, and the wet one, *palustris*.

NUMBERS

Bachman, who followed it throughout its range, says: "It continues to increase in numbers as we proceed southwardly. It is abundant in the swamps of Georgia [and] Alabama."[6]

Referring to its distribution in Florida and Georgia, Bangs says: "The

---

[4] Q. N. A., I, p. 156.

[5] As above, pp. 152–53.

[6] As above, p. 156.

Marsh-rabbit is most abundant in the salt marshes of the coast, where it occurs in great numbers, but is very common also in fresh-water swamps and marshes, and in hummocks."[7]

Finally, an approach to exact measurement is found in this remark by Bachman: "We have known 2 persons kill 20 in the course of a few hours."[8]

Food

The food of this wet-footed member of a bone-dry family is different from that of its kinsmen only by virtue of its different opportunities. As Bachman says:

"The Marsh-hare never, that we are aware of, visits gardens or cultivated fields, but confines itself throughout the year to the marshes. It is occasionally found in places overflowed by salt, or brackish, water, but seems to prefer fresh-water marshes, where its food can be most conveniently obtained. It feeds on various grasses, and gnaws off the twigs of the young sassafras, and of the pond-spice (*Laurus geniculata*). We have seen many places in the low grounds dug up, the footprints indicating that it was the work of this species in search of roots. It frequently is found digging for the bulbs of the wild potato (*Apios tuberosa*), as also for those of a small species of amaryllis (*Amaryllis atamasco*).

"We kept an individual of this species in confinement, which had been captured when full-grown. It became so gentle in a few days that it freely took its food from the hand. It was fed on turnips and cabbage-leaves, but preferred bread to any other food that was offered to it."[9]

ENEMIES AND DISEASES

There is no reason to suppose that the birds and beasts of prey recognize the fine distinctions that scientists proclaim between the various Rabbits. Therefore, Cottontail, Cane-cutter and Pontoon are similarly beset, so far as anyone knows.

Says Bachman: "This species, like all others of the genus existing in this country, as well as the Deer and Squirrels, is infested with a troublesome larva of an œstrus in the summer and autumn; which penetrating into the flesh and continually enlarging, causes pain to the animal and renders it lean."[10]

---

[7] Land Mammals, p. 173.

[8] Q. N. A., I, p. 156.

[9] As above, p. 155.

[10] As above.

FLESH AND TRACK

"This species possesses a strong marshy smell at all times, even when kept in confinement, and fed on the choicest food. Its flesh, however, although dark, is fully equal, if not superior, to that of the Gray-rabbit."[11]

"Its track when observed in moist or muddy situations differs very much from that of other species. Its toes are spread out, each leaving a distinct impression like those of the Rat."[12]

MATING AND NEST

In general, no doubt, its mating customs and ceremonies resemble those of the Cottontail. But it differs considerably in its nesting.

Says Bachman: "The Marsh-hare deposits its young in a pretty large nest, frequently composed of a species of rush (*Juncus effusus*), growing in convenient situations. The rushes appear to be cut by it into pieces of about a foot in length. We have seen these nests nearly surrounded by, and almost floating on the water. They were generally arched by carefully bending the rushes or grasses over them, admitting the mother by a pretty large hole in the side. A considerable quantity of hair was found lining them, but whether plucked out by the parent, or the result of the natural shedding of their coat, (it being late in the spring, when these animals shed their hair,) we were unable to ascertain."[13]

BREEDING AND YOUNG

The Marsh-hares "evidently breed several times in the season, but we have observed that the females usually produce their young at least a month later than the Gray-rabbit. Twenty-one specimens were obtained from the 9th to the 14th day of April; none of the females had produced young that season, although some of them would have done so in a very few days. On one occasion only, have we seen the young in March."[14]

"The young number from 5 to 7. . . . They bear a strong resemblance to the adult, and may almost at a glance be distinguished from those of the Gray-rabbit."[15]

---

[11] Q. N. A., I, p. 155.

[12] As above, p. 154.

[13] As above, p. 155.

[14] As above, pp. 155–56.

[15] As above.

In the details of growth and development, they no doubt resemble their cousins, the Cottontails.

HABITS

In some of its ways, this Rabbit is like the others of the genus. In its calls, its unsociability, its stamping, its non-resistance to a violent enemy, it resembles its cousins. But in one or two of its habits, it recalls sundry relatives who are more remote.

Thus it seems to have pathways like those of the Jackrabbit and Snowshoe. "In marshes," says Bangs, "it makes beaten runways along which it occasionally darts with astounding rapidity. It takes to the water readily and swims well, the ears and top of the head alone showing above water, with the fore feet splashing in front. Seeing one swimming thus for the first time, no one would think that it was a Rabbit."[16]

And Bachman, still our best authority after 70 years, writes: "In its movements, it is unlike most of our other Hares; it runs low on the ground, and cannot leap with the same ease, strength and agility they display. From the shortness of its legs and ears, and its general clumsy appearance as we see it splashing through the mud and mire, or plunging into creeks or ponds, it somewhat reminds us of an overgrown Norway Rat endeavouring to escape from its pursuers.

"The Marsh-hare is so slow of foot, that but for the protection afforded it by the miry tangled and thorny character of its usual haunts, it would soon be overtaken and caught by any Dog of moderate speed. We have observed the Negroes of a plantation on a holiday, killing a good many of them by first setting fire to the half-dried grasses and weeds in a marshy piece of ground during a continued drought, when the earth had absorbed nearly all the moisture from it, and then surrounding the place, with sticks in their hands, and waiting until the flames drove the Hares from their retreats, when they were knocked down and secured as they attempted to pass.

"Several Gray-rabbits ran out of this place, but the men did not attempt to stop them, knowing their superior speed, but every Marsh-hare that appeared, was headed, and with a loud whoop set upon on all sides and soon captured."[17]

"Some of the habits of this Hare, differ greatly from those of others of the genus; it seeks the water, not only in order the easier to escape from its pursuers, but when in sportive mood; and a stranger in Carolina, should he accidentally see one amusing itself by swimming about, if unacquainted with the habits of the animal, would be puzzled by its manœuvres.

---

[16] Land Mamm., p. 173.

[17] Q. N. A., I, p. 153.

"When the Marsh-hare is startled by the approach of danger, instead of directing its flight toward high grounds like the Gray-rabbit, it hastens to the thickest part of the marsh, or plunges into some stream, mill-pond, or 'reserve,' and very often stops and conceals itself where the water is many feet deep, among the leaves of lilies or other aquatic plants."[18]

Fire may drive it out of its sheltering thicket, but water has no terrors for it. Bachman continues: "After a heavy rain had produced a flood, which inundated some swamps and ricefields near us, we sallied forth to see what had become of the Marsh-hares, and on beating the bushes, we started many of them, which ran from their hiding places, plunged into the water, and swam off with such rapidity that some escaped from an active Newfoundland Dog that we had with us. Several of them, supposing they were unobserved, hid themselves in the water, about 15 yards from the shore, protruding only their eyes and the point of their nose above the surface; when thus almost entirely under the muddy water, with their ears pressed back and flat against their neck, they could scarcely be discovered. On touching them with a stick, they seemed unwilling to move until they perceived that they were observed, when they swam off with great celerity.

"A few evenings afterwards, when the waters had subsided and returned to their ordinary channels, we saw a good many of these Hares swimming in places where the water was 7 or 8 feet deep, meeting, or pursuing each other, as if in sport, and evidently enjoying themselves."[19]

When the Cottontail is confronted by a water hazard on its line of travel, it goes around or makes a mighty effort to leap over; but the Marsh-hare, like the Indian in the North woods, welcomes a chance to travel the water-route. It may not be a quicker way, but is, at least, a safer way.

"We have on a few occasions seen this Hare take to a hollow tree when hard pressed by Dogs, but (as we have just remarked) it usually depends more for its safety on reaching marshy places, ponds, or impenetrable thickets."[20]

BATHING

In line with its propensities for water, is the bathing habit that Bachman noted in one Wet-rabbit which he held captive.

"In warm weather," he says, "it was fond of lying for hours in a trough of water, and seemed restless and uneasy when it was removed; scratching at the sides of its cage, until the trough was replaced when it immediately plunged in, burying the greater part of its body in the water."[21]

---

[18] Q. N. A., I, p. 154.

[19] As above.

[20] As above.

References

1849- Quadrupeds of North America, by Audubon and Bachman, I, pp. 152–56.
1898—Land Mammals of Florida and Georgia, by Outram Bangs, March, p. 173.
1921—Biological Survey of Alabama, by A. H. Howell, *N. A. F.*, 45, pp. 73–74; 1 map.

---

[21] Q. N. A., I, p. 155.

LIFE CII PYGMY RABBIT

PAGE

Names 840
Description: Size, Colour 840
Range 841
Haunts 841
Habits 842
Social Instinct 843
Running Habit 843
Den 843
Young 844
Diurnal and Nocturnal 844

References 845

The Pygmy Rabbit of Idaho, Short Rabbit, Burrowing Rabbit

Brachylagus idahoensis (Merriam)

(Greek *brachus*, short, on account of its all-round shortness; *Lagos*, Hare; L. *idahoensis*, of Idaho.)

Lepus idahoensis Merriam, 1891, *N. A. F.* 5, p. 76, July 30.
Brachylagus idahoensis Miller, 1900, Proc. Biol. Soc. Wash., XIII, p. 157, June 13.

Type Locality—Pahsimeroi Valley, Idaho

This is the only known member of the genus, *Brachylagus*; in fact, said genus was erected by Miller (1900) in order to accommodate this anomalous and elusive creature. While *Brachylagus* resembles *Sylvilagus* (which is mongrel Latin-Greek for the "Wood-hare" i.e., Cottontail) in general make-up, it is distinguished externally, by being much smaller and by a general shortness—head, ears, limbs, and tail all share in the process of abbreviation. Its Squirrel-like skull also is blessed with numerous peculiarities, many of them in the line of shortness.

In life, the creature looks like a cross between a Rat and a Rabbit. It is not unlike a Coney—a resemblance enhanced by the absence of tail.

To the generic characters, it adds the following:

Size. Total length, about 10 in. (254 mm.); tail, about ¾ in. (19 mm.); hind foot, 2¾ in. (70 mm.); ear from notch, 1⅝ in. (41 mm.). A Cottontail's ear is about 2¾ in., and a Jackrabbit's over 5 in., which helps us to realize the shortness of this Pygmy's ears.

Colour. The coat, in spring and summer, may be represented by a male specimen from Minidoka, Ida. It was taken July 25, 1910, by S. G. Jewett; and is as follows:

All above, warm gray, softly peppered with blackish brown, darker on the back and crown. The legs, nape, and ears behind are tinged with warm sienna; the ears inside, the chin and lower parts are dull whitish; there is no pure white anywhere. The upper side of tail, like the back; under-side a little grayer; but the tail—what little there is of it—is practically of one colour throughout, both upper and under-sides, quite unlike that of most Rabbits, and contrasting sharply with that of its nearest cousins, the Cottontails. This is a strong feature.

In less degree important, is the fact that its ears have a conspicuous lining of long gray hairs; probably a result of its underground life, for without some such protection, the loose falling sand might be troublesome.

In winter, it looks like a dull whitish Rabbit. A Feb. 10th specimen from Rupert, Ida., is much paler and grayer all over, except on nape and legs, where the sienna is exaggerated by contrast. Its foot-bristles are enlarged, and it looks as though trying to turn into a Snowshoe, with about 50 per cent. of success.

Range

Map XVI (p. 607) shows the range in outline; but to its broad information, we must add these details: The Pygmy Rabbit is a creature of the dry desert country, where vegetation is very scarce, and running water practically unknown. Wisely, therefore, this child of the sand does contentedly without all the things it cannot get; and it would as soon think of taking a drink of water, as it would of climbing a tree.

Haunts

"This Rabbit seemed to be quite generally distributed throughout the district [Malheur Co., Ore.], where it is recognized by ranchers," says Anthony, "as being distinct from the Cottontail. It has a decided preference for little draws and flats where the sagebrush grows thickly, and where rabbit-brush (*Chrysothamnus*) occurs in extensive patches. In fact, the best way to hunt this animal was to look for the bright yellow of *Chrysothamnus*, and then work that vicinity. Very rarely could one be found at any distance from rabbit-brush. This may have been only a coincidence, for spots where the rabbit-brush grows are generally more luxuriant in vegetation than adjacent localities; but it remains a fact that a dozen Rabbits were seen in places as described above, to every one that could be found out on the sparsely brushed flats and hills. It was mere accident if one *idahoensis* was found where the low sage grew, and conditions suited the other species of the *Leporidæ;* but one might be reasonably sure of seeing several in any extensive growth of rabbit-brush and tall sage. Here they appeared to colonize, and as many as 8 or 10 were seen in a forenoon, on several occasions. On account of the thick growth, and the animal's habit of circling about under cover, an accurate count of the inhabitants of such a locality was difficult to obtain."[1]

---

[1] Mamm. Malheur, p. 22.

HABITS

This is the only Rabbit in our limits that habitually digs and lives in burrows underground; it is a Hare with the habits of a Mouse. It is the smallest of its group; so small that it could not fit into the stalls provided by existing genera, so they had to make a little one for it all by itself. Having said this much, we have given nearly all that is known of this unique and beautiful little by-product of the sagebrush plains.

Its Rat-like size, pale colours, short ears, and apparent absence of tail, make this smallest of our Rabbits easy to know, if you are in the sagebrush during twilight hours; and it will elude you by darting mouselike down some hole, thereby showing that it is no baby Jackrabbit, nor even a young Cottontail. But it avoids observation, and it further abbreviates one's chances of familiarity, by coming out solely after sundown.

Dr. Merriam, who originally discovered and described it, spent two months collecting on its range in 1890, and writes: "That but half a dozen specimens of this little Rabbit were secured during more than two months spent in the very centre of its abundance, seemed very strange to us, until we learned, near the close of the trip, two important facts concerning its habits; namely, that it is almost exclusively nocturnal, and that it makes its home in deserted holes of the Badger (*Taxidea americana*). The only individual I succeeded in shooting, was killed at the mouth of a Badger hole just at daylight; and the specimens trapped, were caught at the mouths of old Badger holes which had been partly filled with earth. Had we learned these facts earlier, we could easily have captured many more. Two or three others were caught, but were eaten in the traps by Coyotes.

"This Rabbit has very short legs; and, in running, keeps close to the ground, not leaping, as most Rabbits do. It was never found away from the plains and valleys covered with sage (*Artemisia tridentata*) and *Tetradymia canescens*."[2]

H. E. Anthony, who studied the Pygmy in Oregon, says that it "did not seem to be as wild as the *Sylvilagus nuttalli* often found in the same spot. *Idahoensis* would start from under a bush, and, in a series of leisurely hops or short runs, if not too greatly alarmed, melt away into the thick cover. Careful following on the trail would discover a ball of brownish fur at the foot of some clump, with eyes watching the back trail, and nervous ears on the alert. Cautious movements would permit approach to within ten or twelve feet. In fact, one great drawback in securing specimens, was this close proximity of the animals. In the thick growth they affect, the hunter does not see one until it has started from under his very feet, where it is manifestly impossible to shoot it; and, before it has reached a distance where it would not be uselessly mangled, the animal has interposed brush between itself and the danger. Pursuit only brings a repetition of this, or finds the Rabbit motionless at ridiculously close range."[3]

---

[2] Mamm. Ida., pp. 75–76.

SOCIAL INSTINCT

"The social instinct might, at first glance, appear to be rather more developed in *Brachylagus* than in other *Leporidæ* of the region, because of this habit of preference for restricted areas; and observations seem to bear this out. Not infrequently, two of the animals were put out from the same clump of brush; and it was generally noted that the residents of each particular area would be found more or less congregated at one part of their chosen district. This was not due to conditions of food supply, evidently, for the next visit might discover them at the opposite end. When one Rabbit was seen, more often than not, others would scurry out too, before any great distance was traversed."[4] "At no time was *B. idahoensis* heard to utter a sound."[5]

RUNNING HABITS

"Doctor Merriam in his remarks on the species when he described it, mentioned the fact that *idahoensis* runs differently from the other Rabbits. This point was well borne out by my observations. The Pygmy runs more in a scurrying manner, like a Ground-squirrel, keeping close to the ground, and rarely leaping as *Sylvilagus* is wont to do. When moving at their leisure, these animals would progress in short hops; but when speed was their desire, they scuttled low to earth."[6]

DEN

Unlike the rest of the group, this small creature of the undertangles has its home very definitely beneath the surface.

However, it does not emulate the European Rabbit by excavating long, complex tunnels for its own use—an underground labyrinth—but uses such ready-made burrows as it can find without an owner.

---

[3] Mamm. Malheur, p. 22.

[4] As above.

[5] As above, p. 24.

[6] As above, p. 23.

Young

Doubtless, its young are born in some far corner of its tunnel; but no one so far has seen and recorded the nesting habit. Probably the young are 4 to 6 in number, but no one knows.

Anthony says: "Young Cottontails and Black-tail Rabbits were often seen in the same thick cover with *Brachylagus;* but so distinctive was the Pygmy that, if one good glimpse was obtained, no doubt as to identity could exist. *B. idahoensis* appears, in life, to be quite bluish-gray or rufous brown, accordingly as the animal has changed its pelage; and its apparent lack of a tail sets it apart from the young *S. nuttalli* with his twinkling tuft of cotton.

"Young of *idahoensis* were seen fairly often, and nearly full-grown specimens were secured. Most of these noted, ranged from two-thirds grown to the mature of the year. One was seen, however, about the size of a man's fist, Aug. 21st; but was lost in thick brush before it could be secured."[7]

Diurnal and Nocturnal

The statement made by Dr. Merriam, says Anthony, "that *idahoensis* is almost exclusively nocturnal, was not substantiated, as far as I could note; nor did I get the impression that this Rabbit was in the habit of using Badger holes for their homes to an extent that would make them difficult to find in the day time. I could be as reasonably certain of seeing *Brachylagus* in the day time as I could be of finding *Sylvilagus;* and the same feeding habits and hours seem to apply to the one as to the other.

"As an instance of their being abroad in the daytime, feeding, several were shot in fairly open spots where the nature of the surroundings made their dwelling in old Badger holes a necessity; and each time the animal was seen at the entrance to the burrow, but far enough outside to show that he had just run up to the burrow from his feeding quarters, on the approach of danger. Where their favourite conditions prevail, none were seen at burrows; and I think that here, the thick brush affords ample protection, and the surface form answers all the requirements for a home, at least during the summer. In such a spot, Rabbits, when seen, were always started from under the brush, and rarely did I drive one to a burrow, as the animal would double and turn, and seek to hide in the brush, a proceeding he would not be apt to resort to if he had a burrow near by in which he was accustomed to seek refuge. But, when he lacked the cover to hide in, as did a few which were seen in more open localities, his one idea was to escape down the first old Badger hole he could find—precisely what one would expect *Sylvilagus* to do under the same circumstances. Once or twice, the Rabbits of a *Chrysothamus* patch, three or four in number, were found at the very outskirts of the cover, and made for the deeper brush when I alarmed them. This was in the later forenoon, and it would appear that the animals were feeding, and had not yet retired to the denser cover for the midday."[8]

---

[7] Mamm. Malheur, pp. 23–24.

REFERENCES

1891—Mammals of Idaho, by C. Hart Merriam, *N. A. F.*, 5, pp. 75–76.
1909—Rabbits of North America, by E. W. Nelson, *N. A. F.*, 29, pp. 275–78; 1 map.
1913—Mammals of Malheur Co., Oregon, by Harold E. Anthony, Am. Mus. Nat. Hist., Vol. XXXII, pp. 22–24.

---

[8] Mamm. Malheur, p. 23.

Easy now.

LIFE CIII—ARMADILLO

PAGE

Names 848

Description: Size, Weight, Colour 848

Armour 849

Races 850

History 850

Range 850

Its Northward March 851

Numbers 852

Haunts 852

Nocturnal Taste and Senses 853

Burrows 853

Mating, Den, and Young 854

Food of the Toothless 855

Excrement 856

Speed 856

Enemies and Their Bafflement 857

Sociability and Voice 860

Domestication 860

His Way of Life 861

References 863

Nine-banded Armadillo, Common Armadillo, or Peba

Dasypus novemcinctus Linnæus

(Gr. *dasus*, thick or rough; *pous*, foot; L. *novem*, nine; *cinctus*, banded)

Dasypus novemcinctus LINNÆUS, 1758, Syst. Nat., ed. 10, Vol. I, p. 50.

TYPE LOCALITY of the form first described, is in South America, probably Brazil; but the type of the Texan and only United States form is from Brownsville near the mouth of the Rio Grande

The Family *Dasypodidæ* includes the Armadillos. They have the body covered with a bony carapace, with 7 to 9 movable ring-joints around the middle; a long pointed snout; long ears; long tail, with scaly rings; front feet with 4 toes, hind with 5, all with strong, slightly curved claws.

As to dentition, the Armadillos go further than some others of their Order, and have dispensed with both canines and incisors, but still retain rows of simple, peg-like molars.

Teeth:

$$\text{Inc. } \frac{0\text{–}0}{0\text{–}0}\text{; can. } \frac{0\text{–}0}{0\text{–}0}\text{; mol. } \frac{8\text{–}8}{8\text{–}8} \text{ or } \frac{7\text{–}7}{7\text{–}7} = 32 \text{ or } 28$$

They have one pair of inguinal mammæ, and one pair of pectoral.

When seen alive, Armadillo is very suggestive of a small, active and very smooth Pig, or a cross between a Snapper and a Razorback.

In addition to the characters of its group, a typical Rockport, Tex., specimen of nine-banded Armadillo has:

Size. Total length, 28½ in. (723 mm.); on the dry skin of which tail is 13 in. (330 mm.); hind foot, 3¼ in. (82 mm.).

Weight. 12 to 15 lbs.

Colour. In the museum skin, it has no colour that is pigmentally describable; simply a purple-brown horn-tint darker on the back, much lighter on the tail and sides; varied, however, with dark blotches. But a recent specimen before me, is beautifully variegated with spots and triangles of delicate flesh colour on a background of very dark gray, nearly black. On the tail, feet, snout, and edges of the shell, the flesh tint deepens into a delicate rose colour.

In regions of black soil, this creature is commonly darker than in sandy places. The difference is probably due to mechanical staining of the shell.

ARMOUR

The Armadillo is everywhere covered with beautiful, sculptured and regular horny plates, even on the ears where they are very small and delicate. On the inner side of the legs and on the belly, where not needed, rigid economy has reduced the plates to little or nothing, using instead the cheaper material of bristles, a few of which are scattered on the back between the bony plates and bands. The body armour is broken by 9 rings or banded joints, which are broad on the sides, and narrow on the back, where, indeed they are reduced to 8.

The tail has 14 rings--horny joints that look as though they would telescope into each other—and a final 4 or 5 inches of scaly tip, like the tail of a snake sticking out of the last joint.

The sharp, strong claws or hooflets, when well worn, remind one of the claws of a turkey that has had to scratch gravel all summer.

The long, thin, extensile tongue is covered with a stuff as sticky as fly-paper. This the creature shoots out, and lashes about among insect swarms; and so feeds riotously on what most animals would consider not proper food.

So much for the dry details of this little armoured car. But one must have had a long training in mediæval harness-equipment to appreciate the exquisite hand-made workmanship on this extraordinary little brute. Its armour is of harmonious make throughout, of the hardest available material; yet no two portions of it are quite the same. Each part has a style suited to its own brunt or need of souplesse. The whole is a combination of case armour, chain mail, and metal bosses on leather—Roman, Saracen, and Middle English, whichever best suits the need—and softly graded into each other. It looks as though handmade by a smith of consummate skill, an armourer and an artist. For it is full of beautiful lines and patterns; it is light, and it works so perfectly that there is never a squeak or a rattle, never a loose joint or a missing part, no gap for the weapon of a foe to enter.

It is so effectual, indeed, that the Armadillo is enlarging its range.

RACES

The typical form is *novemcinctus* Linnæus, from Brazil. Besides this, three races have been described from the North American continent, and one from the West Indies, as follows:

mexicanus Peters, with frontal region of skull, high and inflated. T. l., Colima, Mex.

texanus Bailey, like *mexicanus*, but with heavier dentition, and larger plates on forehead and wrists. T. l., Brownsville, Tex.

fenestratus Peters, intermediate between *novemcinctus* and *mexicanus*. T. l., Costa Rica.

hoplitis G. M. Allen, similar to *novemcinctus*, but smaller; skull smaller, with tooth-row decidedly shorter. T. l., Lesser Antilles.

HISTORY

The earliest notice I find of this quaint little beast is in Samuel Purchas' "Pilgrimages," 1617, Book III, p. 909, "Of the Beasts, Fowles and Plants in America: The Armadillo is an admirable creature, of which there be diuers kinds: they resemble a barded [armoured] Horse, seeming to be armed all ouer, and that as if it were rather by artificiall plates, opening and shutting, then naturall scales: it digges vp the earth as Conyes and Moules."

RANGE

The Armadillos are an American product. They are not found in any part of the Old World, although their African cousins, the Manis and Pangolin, have many features in common with them, including their membership in the Edentata. Their centre of abundance is the warm parts of South America from Argentina northward. The Nine-banded is spread from Argentina to Texas; and is, of course, split into many races, corresponding with the numerous environments in which it is found. Vertically, it ranges from sea level to about 10,000 feet of elevation.

Expressed in good, set, biological terms, the Armadillos in Texas are creatures of the "strictly Lower Sonoran, but in the rough country between Rock Springs and Kerrville, they range fairly into the edge of Upper Sonoran Zone. As a rule, they do not extend east of the semi-arid or mesquite region, nor to any extent, into the extremely arid region west of the Pecos, but occupy approximately the semi-arid Lower Sonoran region of Texas, north to near latitude 33°,"[1]

---

[1] Bailey, Texas, p. 54.

Its Northward March

The Armadillo is a successful species. It has solved its immediate problems, and hence, is adding to its range, instead of receding before the encroachments of settlement. This means, of course, that the settlers are harder on the creature's enemies than on itself, so that an ever-growing balance is struck in the Armadillo's favour. How such rare statements do give the naturalist a thrill of joy!

According to H. P. Attwater: 'When in Port Levaca last week, I obtained some notes in regard to Armadillos, which may be of interest. Mr. J. M. Boquet, a very intelligent and reliable ranchman, says that these animals were first noticed in Calhoun County in 1886 or about that year; that they are now very common, and that he has no doubt there are hundreds of them in the county to-day. He says their favourite resort on the prairie ranches is in the long Cherokee-rose hedges, which have been grown in many parts of that and adjoining counties as a wind-break in winter for Cattle. During the last few years, since Armadillos have become so common in the Southwest and south-central Texas, I see baskets made of Armadillo skins or shells in the curio stores at San Antonio and other places."[2]

In the *Journal of Mammalogy* for Aug., 1926 (pp. 206–10), John K. Strecker gives full details of the Armadillo's recent and triumphant march eastward and northward from the mouth of the Rio Grande. He says in summary: "Until about the early '70's of the last century, the Lower Rio Grande Valley was the principal home of the Armadillos in Texas."[3]

He continues: "In order for the Armadillo to extend its range, it was first necessary for it to cross the Rio Grande at low water. The high mountainous region west of the Pecos River seems to have formed somewhat of a barrier, so the trend of migration was northeastward rather than northward. In the '70's, the animals had already worked their way across the Nueces; and a short time later, were in the San Antonio River Valley. In 1890, they had reached the Colorado, and by 1895, they probably had penetrated to the Brazos Valley. At the present time, they are found in the drainage areas of the Trinity and Neches rivers; and from the above indicated data, have at Hemphill almost crossed the Sabine; and a little higher up, have already crossed that stream into the alluvial bottoms between the Sabine and Red rivers. . . . In eastern Texas, it seems to be occupying the territory formerly inhabited by the Peccary and the Ocelot."[4]

---

[2] Bailey, Texas, p. 54.

[3] Extension, p. 207.

[4] As above, p. 210.

After mentioning some Negro reports that in northwestern Louisiana, there was a "dry lan' varmint, wid er turpin (terrapin) shell," Strecker adds: "Last summer, however, I found my friend, Mr. L. S. Frierson, Jr., of Gayle, La., in possession of the tail of a specimen which had been killed 2 miles north of Westdale, Red River Parish."[5]

There seems to be no climatic or ecological reason why this interesting and harmless animal should not spread over all of the Southern States south of latitude 32°.

NUMBERS

Where found at all, the Armadillo is commonly in large numbers. Bachman says: "We have heard that in some parts of Nicaragua, the Armdillos are so common that they can be purchased for a medio—six and a quarter cent piece"[6] which may prove either the abundance of Armadillos or the scarcity of cash, according to the further light.

A more exact, as well as picturesque, illustration is given by Bailey: "In Autumn," he says, "during the Deer-hunting months, when the young of the year are full-grown, they [the Armadillos] are especially numerous; and particularly obnoxious to the still-hunters who repeatedly mistake their rustling in the leaves for the noise of feet of bigger game. Where a dozen or 20 Armadillos are met in a day's hunting, as sometimes happens, and possibly no Deer are seen, the nervous strain and disappointment on the part of the hunter sometimes result in serious consequences to the innocent Armadillo."[7] To which he adds: "Almost every rock-walled gulch along the headwaters of Guadaloupe River has one or more dens"[8] of this interesting little armoured Pig.

HAUNTS

Capt. J. P. McCown who lived in Texas during the early '40's, told Audubon that at that time, "the Armadillo is to be found in the chaparrals on the Rio Grande. I have seen their shells or coat-of-mail on the prairies; whether carried there by larger animals, or birds, or whether they inhabit the prairies, I cannot say."[9]

"This Armadillo lives by preference amid the cover afforded by the forests, brushy jungle, tall grass, or other vegetation. In the midst of such shelter, it usually digs its own burrow a few yards deep in a bank or hill slope, beneath a stump, under the roots of a tree, or a rock, or even on level ground."[10] But it commonly occupies small natural caves in hillside or among rocks.

---

[5] Extension, p. 207.

[6] Q. N. A., III, p. 225.

[7] Texas, p. 56.

[8] As above, p. 55.

[9] Q. N. A., III, p. 224.

Bailey says: "They are partial to low, dense cover of coarse grass, thorny thickets, cactus patches, and scrub oaks, under which they make numerous burrows and trails, or root about in the leaves and mould, where they enjoy comparative safety under the double protection of leafy screen and armour plate. But they thrive best in a rocky country, especially where limestone ledges offer numerous caves and crevices of various sizes, from which they can select strongholds that will admit no larger animal."[11]

To which Strecker adds: "Its ability to suit itself to various physical conditions, is one of the most remarkable things in connection with its range extension. It seems to be equally at home in alluvial creek bottoms, the edges of swamp tracts, rock-walled gulches, limestone hills, chaparral prairie, and sandy islands."[12]

NOCTURNAL TASTES, AND SENSES

The Armadillo is commonly listed as a strictly nocturnal animal. We have already encountered reasons to warn us against making any animal ever strictly anything. And, of course, the Armadillo also comes forward with some flagrant breaches of the "strictly nocturnal" law. For many observers have seen the creature up and doing merrily in the very glare of noonday. It is worthy of note that all animals which burrow underground, and spend much time in the gloom of dark caves, find it necessary to come out occasionally for the tensifying tonic of a strong sunbath.

It seems to be a rule, for reasons more or less obvious, that no underground animal sees well. The armour-bearer's eyesight is so poor, says Nelson, that one "may approach openly within about 30 yards before being noticed."[13]

BURROWS

The Armadillo is highly specialized in many ways; one might say in most ways—anatomy, exterior, and habits. One of its unusual gifts is its power as an excavator, for it has the body of a Badger, and the claws of a gigantic Mole. Whenever it has nothing better to do, it digs a hole. It digs for food, it digs for a bed, it digs for escape, it digs for a home, it digs for a nursery, and it digs for fun. It spends much of its time underground, mining like a Mole. Roosevelt relates that "twice, while laying railway tracks near São Paulo [Brazil], Kermit had accidentally dug up Armadillos with a steam shovel."[14]

---

[10] Nelson, W. A. N. A., p. 585.

[11] Texas, pp. 54–55.

[12] Extension, p. 210.

[13] W. A. N. A., p. 585

One naturalist, Audubon, says that these holes "are generally dug at an angle of 45°, are winding, and from 6 to 8 feet long."[15] Then he adds: "Their holes are often dug in the sides of steep banks or hills, and in thick and dense parts of the woods."[16]

"But," he continues, "when the Armadillo has a chance of escape by digging into ground, it is no sluggard in its movements, and progresses towards the depths of the soil with surprising rapidity."[17]

Animals which dig, have usually three or four different types of burrow: —the food burrow,—a mere prospect shaft sometimes developed into a profitable mine; the home den; and the playground. We know little about the Armadillo's activities in any of these.

Mating, Den, and Young

What the mating customs are, is utterly unknown. Nothing but the fact that the creature does make a home den is on record.[18]

In North America, this side of the Rio Grande where we have definite winter and summer, the young are born from February to April.

Vernon Bailey tells me that the Armadillo invariably has 4 young, never more.[19]

"They have their eyes open at birth," says Nelson, "and the armour is soft and flexible like fine leather. The hardening of the skin into a bony armour is progressive, continuing until after the animal fully completes its growth. As soon as the young are able to travel, they trot along with the old one, during her foraging trips."[20]

"Early one afternoon," continues this naturalist, "when riding along a trail in the heavy forest of southern Oaxaca, accompanied by an Indian boy and a pack of Dogs, I suddenly came upon an old Armadillo and 8 young [evidently two families, V. B.] about two-thirds grown. They had heard our approach, and stood motionless in a compact little group, half hidden in the grass. I had barely time to stop my Horse, when the Dogs spied them and made a rush. The Armadillos darted into the undergrowth in every direction like a litter of Pigs, and with the exception of two caught by the Dogs, gained safe refuge in their burrow. This we found dug in the level ground about 50 yards from where we encountered them."[21]

---

[14] Braz. Wild., p. 88.

[15] Q. N. A., III, p. 224.

[16] As above, p. 225.

[17] As above, p. 223.

[18] See Azara.

[19] Personal letter, March 3, 1927.

[20] W. A. N. A., p. 585.

FOOD OF THE TOOTHLESS

Every highly specialized animal is, first of all, specialized for peculiar food.

"The principal food of this genus," says Audubon, "consists of ants of various species, which are so abundant in some portions of Central and South America as to be great pests to the inhabitants of those parts of the world."

This species, he continues, "we were informed by Captain Charles H. Baldwin, [is] kept in Nicaragua, not only by the people of the ranchos, but by the inhabitants of some of the little towns, to free their houses from ants, which, as is said, it can follow by the smell. When searching for ants about a house, the animal puts out the tongue, and scrapes the ants into the mouth from around the posts on which the houses are raised a little above the ground, and has been known to dig down under the floors, and remain absent for 3 or 4 weeks at a time. . . . They are said to dig down in a straight direction when they discover a subterranean colony of ants, without beginning at the mouth or entrance to the ant-hole. There are two favourite species of ant with the Armadillo in Nicaragua, one of which makes nests in the forks of trees in the forests. The tree ants [termites] are white, the others small and black. The Armadillos keep about the roots of the trees in order to feed upon the former, and as we have already said, dig for the latter.

"They also root up the ground with their Pig-like snout, and do some damage to gardens. They are very persevering when in pursuit of ants, and whilst they turn up the light soil with the snout, keep the tongue busy taking in the insects.

"It has been assured us that when a line of ants (which may sometimes extend some distance in the woods) are busily engaged in carrying provision to the general storehouse, they scatter in every direction at the instant the Armadillo begins to dig down towards their stronghold, evidently having some communication from headquarters equivalent to '*sauve qui peut.*'"[22]

---

[21] W. A. N. A., p. 585.

[22] Q. N. A., III, pp. 223–24.

To this he adds that "Armadillos are said to eat young birds, eggs, snakes, lizards, etc."[23]

Nelson ascribes to it a still wider range of diet. "The food of the Armadillo," he says, "consists almost entirely of many species of insects, among which ants appear to predominate. When searching for food, the animals become so intent that they may be cautiously approached and closely observed, or captured by hand. They root about among fallen leaves and other loose vegetation and soft earth, now and then digging up some hidden grub or beetle. At night they visit newly ploughed fields in their haunts, rooting in the mellow earth. They are accused of digging up plants in gardens during their nocturnal wanderings, and in Texas have been charged with robbing hens' nests of eggs, and of reducing the supply of wild turkeys and quail by breaking up the nests, all of which needs confirmation. Their method of feeding appears to vary considerably, as they have been seen rising on their hind legs to secure small caterpillars infesting large weeds.

"The insect food eaten by the Nine-banded Armadillo Texas, as known from examination of stomach contents, covers a wide range of insect and other small life, including many species of grasshoppers, crickets, roaches, caterpillars, beetles, ants, spiders, centipedes, and earthworms. As the list includes also wire-worms and other noxious species, these inoffensive animals deserve thorough protection as a most useful aid to the farmer."[24]

EXCREMENT

So singular a gastronomic history is properly capped by a remarkable output of "scats." See Plate CXIII (p. 891). Bailey says: "The excrement of the Armadillos found scattered along the trails in the form of clay marbles, and with the texture of baked mud, gives some clue to the food habits of the animals. Careful examination shows only the remains of insects, mainly ants and a few small beetles, embedded in a heavy matrix of earthy matter."[25] Deer make their marbles of wood fibre.

SPEED

The first time I saw a living Armadillo, I got a great surprise. Its tortoise-like appearance prepared me for a creature tortoise-slow. Yes, and some books of good repute had led me to expect a slow-moving, logy thing ready to shut up like a clam at the least sign of danger. But this creature was trotting briskly about like a caged Fox, even galloping at times; and when I succeeded in getting my hand on its back, it gave me a strange thrill to find it warm, almost hot.

---

[23] Q. N. A., III, p. 223.

[24] W. A. N. A., p. 585.

[25] Texas, p. 56.

One of the best pictures of the Armadillo at home and "carrying on" is from the pen of Roosevelt. It shows the real Armadillos as he saw them in Brazil—a larger species than ours, but of similar habits.

"Early one morning," he says, "we came across two Armadillos—the big Nine-banded Armadillo. We were riding with the pack through a dry, sandy pasture country, dotted with clumps of palms, round the trunks of which grew a dense jungle of thorns and Spanish bayonets. The Armadillos were feeding in an open space between two of these jungle clumps, which were about 100 yards apart. One was on all fours; the other was in a squatting position, with its fore legs off the ground. Their long ears were very prominent.

"The Dogs raced at them. I had always supposed that Armadillos merely shuffled along, and curled up for protection when menaced; and I was almost as surprised as if I had seen a turtle gallop when these two Armadillos bounded off at a run, going as fast as Rabbits. One headed back for the nearest patch of jungle, which it reached. The other ran at full speed—and ran really fast, too—until it nearly reached the other patch, 100 yards distant, the Dogs in full cry immediately behind it. Then it suddenly changed its mind, wheeled in its tracks, and came back like a bullet right through the pack. Dog after Dog tried to seize it or stop it, and turned to pursue it; but its wedge-shaped snout and armoured body, joined to the speed at which it was galloping, enabled it to drive straight ahead through its pursuers, not one of which could halt it or grasp it; and it reached in safety its thorny haven of refuge.

"It had run at speed about 150 yards. I was much impressed by this unexpected exhibition; evidently this species of Armadillo only curls up as a last resort; and ordinarily trusts to its speed, and to the protection its build and its armour give it while running, in order to reach its burrow or other place of safety."[26]

ENEMIES AND THEIR BAFFLEMENT

The Armadillo would not be the good fellow he is, if his world did not abound in hostile possibilities that he is just able to outwit. There is nothing like a few enemies for making a triumphant good fellow.

Concerning his internal troubles and ailments, we know nothing. But it is safe to say that every big flesh-eating bird and beast is ready to devour the mail-clad one, provided they can catch and master him. Just what and which these enemies are, is not fully recorded; but it must surely take a creature of mighty jaws or talons to penetrate the panoply of this, the original armoured car.

---

[26] Braz. Wild., pp. 87–88.

Nelson says: "I have found the remains of many Armadillos where they had been killed and eaten by Coyotes or other predatory beasts."[27] More than this I do not find. I cannot even learn that, like most creatures of the tropics, he has a continuous desperate fight with insect parasites.

The Armadillo has three answers for a foe big enough to be dangerous. The first and simplest is to run away; and how effectively he does that, has already been set forth in the section on Speed. The second is to "dig himself in." This he does with promptness and energy when, to his way of thinking, it is the one wise answer to the problem—though he and you may have formed different conclusions on the situation. The third is to curl up in a ball—to demonstrate his complete parallelism to the Box Turtle.

Audubon writes: "This animal, however, on being much alarmed, rolls itself up, and does not attempt to fly; and it is chiefly when it has been digging, and is at or near the mouth of a hole, that it tries to escape; preferring, generally, to be kicked, tumbled about with a stick, or be bitten at by a Dog, to making an effort to run."[28]

When alarmed, the Armadillo immediately runs to shelter. In Mexico, Nelson considers it slow enough to be overtaken by a man, and "may easily be caught in one's hands, especially if intercepted on the way to its den. When caught, it will struggle to escape; and while it may coil up in a ball in the presence of a Dog or other mammal foe, I never saw one try to protect itself in this way."[29]

A final touch given as hearsay by Audubon, and to be read with reserve, is this statement: "We have heard it asserted that when it has the advantage of being on a hill or elevated spot, the Armadillo, upon the approach of danger, forms a ball-shaped mass of its body, with the tail doubled under the belly, starts down the hill, and rolls to the bottom."[30]

In the way of a fighting self-defence, be it noted, the Armadillo can lash out vigorously with its hoof-like claws, front and hind; for it has great strength of limb, and can inflict quite a wound if it hit fair and square on an unprotected part. Even if lifted by the tail, it often succeeds in reaching the incautious hand with a sharp-toed kick. It can bump hard against a small

---

[27] W. A. N. A., p. 585.

[28] Q. N. A., III, p. 223.

[29] W. A. N. A., p. 585.

[30] Q. N. A., III, p. 223.

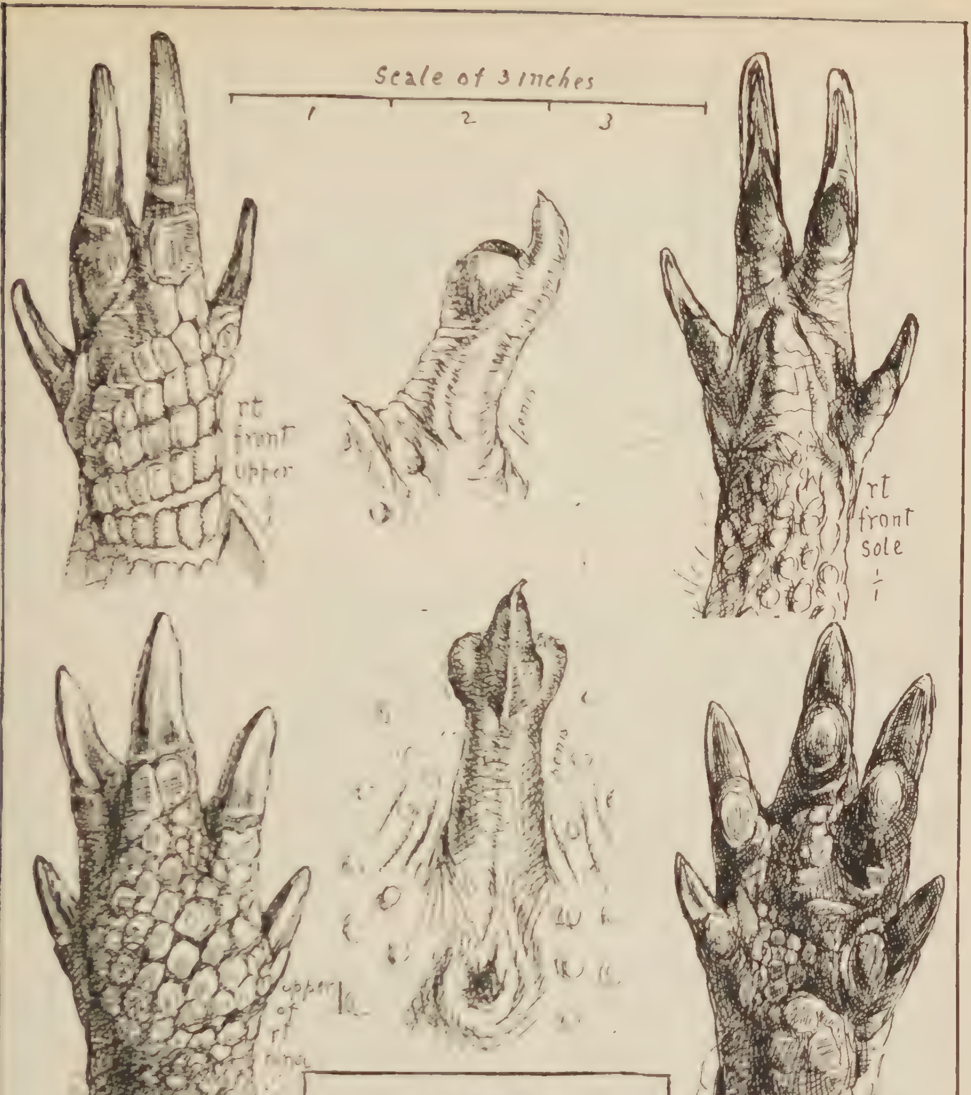


Plate CVIII. Texan Armadillo, ♂. slightly reduced enemy, or sit on him as Hudson describes one species doing to a snake.[31] But one thing it never can or will do—that is, bite; for it has no teeth for such an attack. Audubon gives an incident, showing its disposition, as well as its methods under provocation. "In general, the Armadillo does not evince any disposition to resent an attack; and, in fact, one of them, when teased by a pet parrot, struck out with its claws, only till pressed by the bird, when it drew in its head and feet; and, secure in its tough shell, yielded, without seeming to care much about it, to its noisy and mischievous tormentor, until the parrot left it to seek some less apathetic and more vulnerable object to worry."[32]

Two manœuvres there seem to be that the Armadillo does not reckon in his repertoire—swimming and climbing a tree.

Sociability and Voice

It is a sociable little beast. "Two or three of these animals generally keep together [in their burrows], or near each other; and the Negroes always expect to kill more, when they have captured one."[33]

Old Æsop makes merry over the incongruity of the Porcupine and the Serpent living sociably together. It would be pleasant if we could hear that ancient romancer discuss the case recorded by Nelson:

"Armadillo burrows sometimes accommodate strange neighbours, as was shown by one in Texas which was dug out, and in addition to containing the owner in his den at the end, was found to be occupied by a 4-foot rattlesnake and a half-grown Cottontail Rabbit, each in a side chamber of its own."[34]

The only suggestion that this odd creature has a voice, is in this note by Audubon: "When burrowing, this species utters a slight squeak, quite faint, however."[35]

Domestication

In many parts of the Southwest, the Armadillo is caught young, and raised as a household pet, exactly as in Europe, they keep the Hedgehog—that is to kill off noxious insects. Audubon says that he saw many such, and that they appeared quite tame. Indeed the one from which he made his drawing was a pet, washed clean to have its portrait taken.

---

[31] Naturalist in La Plata, 1892, pp. 72–73.

[32] Q. N. A., III, p. 223.

[33] As above, p. 225.

[34] W. A. N. A., p. 585.

[35] Q. N. A., III, p. 224.

In illustration of its house habits, as well as its Badger-like strength of limb, Audubon adds:

"A friend of ours who formerly resided in South America, had a pet Armadillo in his bedchamber, where it generally remained quiet during the day, but in the dark hours, was active and playful. One night after he had gone to bed, the Armadillo began dragging about the chairs and some boxes that were placed around the room, and continued so busily engaged at this occupation that our friend could not sleep. He at length arose and struck a light, when, to his surprise, he found boxes he had thought greatly too heavy for such an animal to stir, had been moved and placed together so as to form a sort of den or hiding place in a corner, into which the animal retreated with great apparent satisfaction, and from whence it could only be drawn out after a hard struggle, and the receipt of some severe strokes from its claws."[36]

His Way of Life

Darkness is over the dry Southwest, and black darkness fills the canyons where rocky fissures are the homes of Armadillos not a few. Each one, or each pair, maybe, has a definite home and a pathway issuing forth—deep and worn and forking like a much-branched tree, till the last small twigs are lost and merged in the foliage of the world about, perhaps a half mile from the home. And nosing, trotting, stopping, sniffing, comes the Armadillo for his nightly feast. Trot, trot, trot, he goes, silent but for the sharp taps of his toes; stopping at every promising smell, or even making slow haste in a lumbering gallop if something happens to alarm his stolid little soul. But his usual speed is slow, and not maintained. Soon he jogs along his Pig-like way.

It seems likely that the pathway he first takes, leads to some drinking place. His hoof-like tracks are thickly pattered in the mud of the margin. His nose prints show deep at places, where he was rooting in the mire for food; and oftentimes the corrugated-iron impressions of his sculptured mail give proof that the little armoured Pig did not only drink and root like his big namesake, but took mud-baths—cooling, pleasant, and cleansing.

"Other trails," says Bailey, "lead along rocky shelves, up the sides of gulches, and away from thicket to thicket; and are easily followed sometimes for half a mile till they branch and scatter, or connect with cattle trails, where the ropelike prints of dragging, horny tails are visible among the dusty cow tracks. Late in the afternoon, one occasionally meets an Armadillo trotting vigorously along a trail on his stumpy little feet, his tail dragging after him in a useless sort of way as he hurries nervously across the open spaces, and stops in the thickets to nose about under the leaves in search of dainties from the fragrant soil. At such times the long, pointed nose seems to be the keenest organ of sense. The little eyes, half the time buried in rustling leaves, rarely detect an object not close by and in motion. I have followed one of these preoccupied little animals for half an hour, often within 20 or 30 feet, moving only when it was rustling in the leaves, and watching its motions without being discovered or creating alarm.

---

[36] Q. N. A., III, pp. 222–23.

"Hunters say that if you stand still the Armadillo will sometimes bump against your feet without discovering you, so short-sighted are they, and so intent on their own business. But when alarmed, they get over the ground with a rush that is surprisingly rapid considering their turtle-like build. If the first rush does not carry them to cover, and an enemy overtakes them, they curl up in an ironclad ball that is not easily uncurled."[37]

This curling into a ball is the only unpiglike part of his behaviour. His making and keeping to convenient paths, his sifting of the ooze, his wallowing in the mud, and above all, his rooting eternally—rooting for anything that smells like calories, carbo-hydrates, or nitrogenous possibilities—is eminently porcine. So that we are not surprised to learn from Audubon and Bachman that "its flesh is eaten by the Spaniards and natives. It has been described to us by Americans who ate of it during the Mexican War, to be about equal to the meat of the Opossum; we have heard, however, from South Americans, that it is considered quite a delicacy, being white, juicy, and tender; it is cooked by roasting it in the shell."[38]

Had such a weird beastie occurred in England, Ireland, or Scotland, he would have furnished the spinal column for a thousand myths and proofs of strange embodiments in diverse forms. To show that this mystic mood has a place in America, I quote from Nelson a curious myth: "The Maya Indians of the Peninsula of Yucatan have a legend that the black-headed vulture (*Catharista atrata*) in old age changes into an Armadillo. The tale runs that, when a vulture becomes very, very old, it notifies its companions that the time has come, and alights before a hole in the ground that resembles the den of an Armadillo. The other vultures bring food, and the old one remains there for a long time. Its wings disappear, the feathers are lost, and when the change is complete the newly created Armadillo enters the hole, and begins its new life. If skepticism is expressed as to this metamorphosis, the Indians point out, as proof of the legend, the similarity between the appearance of the bald pate of the vulture and that of the Armadillo."[39]

---

[37] Texas, pp. 55–56.

[38] Q. N. A., III, p. 225.

[39] W. A. N. A., pp. 585–86.

REFERENCES

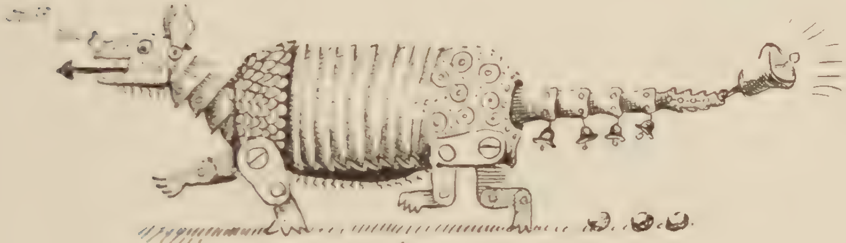
1849–51—Quadrupeds of North America, by Audubon and Bachman, III, pp. 222–25.

1905—Biological Survey of Texas, by V. Bailey. *N. A. F.*, 25, pp. 52–56.

1914—Through the Brazilian Wilderness, by Theodore Roosevelt.

1918—Wild Animals of North America, by E. W. Nelson, pp. 584–86.

1926—The Extension of Range of the Nine-banded Armadillo, by John K. Strecker, *Journ. Mamm.*, Aug., pp. 206–10.

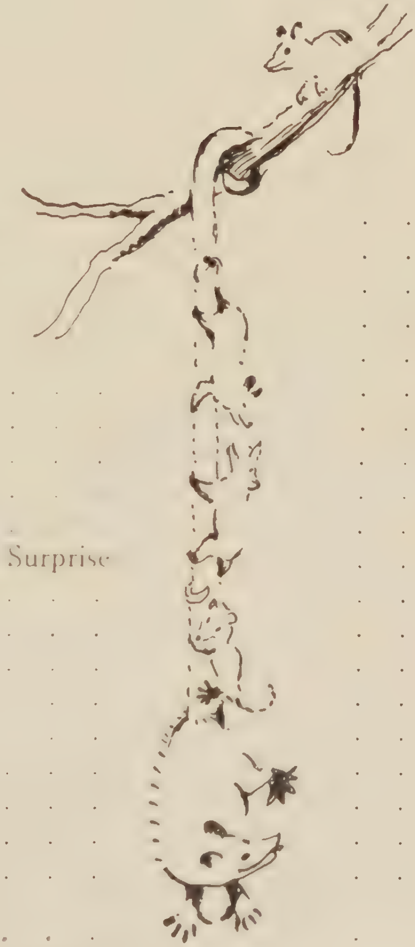


Impressionist Drawing of Armadillo — E. T. S.

LIFE CIV—THE OPOSSUM

PAGE
Names 866
Description: Size, Weight, Colour, Colour Mutations 866
Races 867
History 868
Range 868
Recent Records 869
The Possum in California 870
Haunts 871
Numbers 871
Home Range 872
The Tail 872
The Den 873
Mating, Gestation, and Breeding 874
Broods 875
Young 876
How They Reach the Pouch 877
The Birth of a Brood 878
Number of Pouch Young 880
The Young in Mother's Care 880
Voice 881
Gait—Waddle and Swing 882
The Low-brow Possum 882
Behaviouristic Details: Solitary, A Surprise 884
A Night Prowler 885
Playing Possum 885
Domestication 887
Food 888
Cannibalism 890
Enemies 892
Non-hibernant 893
Sanitation 894
His Way of Life 895

References 897



Opossum or Possum

Didelphis virginiana Kerr

(Gr. *di*, double; *delphos*, womb; L. *virginiana*, of Virginia)

Didelphis virginiana, Kerr, 1792, Anim. King., p. 193.

Type Locality—Virginia

Lenape, *Much-woa-pingus* (Brinton and Anthony).
Santee Sioux, *Singteshda-tanka* (Big Rat) (Williamson).
Choctaw, *Shukata* (Byington).

Opossum, Opassum, or M'possum were the Indian names in Virginia (J. Brickell Nat. Hist. North Carolina, 1737, Dublin).

The Family *Didelphidæ* or Opossums consists of marsupials of small size. They are furry creatures, with short limbs, 5 toes on each foot, naked, prehensile tail, and usually a pouch to carry the young. They are of arboreal habits. All belong to America. They are found from Lake Ontario in eastern North America to Patagonia.

The genus *Didelphis* belongs to this Family. In addition to these Family characteristics, it has the following:

Feet, with 5 distinct toes—all with claws, except the thumb on the hind foot; incisors, small and pointed; canines, large; premolars, with compressed pointed crowns.

Teeth:

$$\text{Inc. } \frac{5-5}{4-4}\text{; can. } \frac{1-1}{1-1}\text{; prem. } \frac{3-3}{3-3}\text{; mol. } \frac{4-4}{4-4} = 50$$

To the above Family and generic characters, the Possum adds the following:

Size. Total length, $29\frac{1}{8}$ in. (740 mm.); tail, 15 in. (381 mm.); hind foot, 3 in. (76 mm.); ear, height from crown, 2 in. (51 mm.).

Weight. A female which I weighed at Cos Cob, Conn., was 12 lbs. Bailey records a large male weighing 8 lbs.[1]

---

[1] Mamm. D. C., Proc. Biol. Soc. Wash., May 1, 1923, p. 106.

Colour. The general impression is of a coarse-haired, grayish-white animal, with a white face and dark-socketed eyes, like holes burnt in a blanket.

Its ears are naked and black, with white or flesh-coloured outer half. Feet, black; toes, naked and flesh-coloured, reminding one of the black, fingerless mitts our grandmothers used to wear. Tail, naked, scaly, and flesh-coloured.

Colour Mutations. In the *Journal of Mammalogy* for Aug., 1922,[2] Prof. Carl Hartman calls attention to the colour mutations in the Possum. Many animals, like the Eyra Cats, have two colour phases, a red and a gray. Now, it seems that the Opossum has four phases:

"1. The gray phase, with underfur black-tipped, overhair all white.

2. The black phase, with underfur also black-tipped, overhair altogether or for the most part, black.

3 and 4. Like 1 and 2, with brown pigment replacing the black."[3]

The cause of these colour variants is unknown.

The percentage of blacks in central Texas is probably near 10 per cent.

The fact that this dichromatism is individual, not racial, is evidenced by the following: C. S. Brimley says of a family taken in Union Co., N. C., Feb. 20, 1897: "Fourteen well-furred young (272–290 mm. total length) caught in hollow at base of tree, together with an adult female on Aug. 4, 1891; 7 of these had the long hairs mainly black, and the other 7 had them mainly white."[4] Hartman further writes me, Jan. 13, 1927, that he has a black female with both black and gray young in her litter.

The supposed Southern race of *virginiana*, named *pigra* Bangs, is probably nothing more than the black phase. In the kindred species, *D. marsupialis texensis*, the black phase predominates.

Albinos of this species are recorded in the N. Y. Zoological Bulletin, Nov., 1921, and by W. K. Cuyler.[5]

RACES

The following forms have been recognized:

virginiana Kerr, the typical form. T. l., Virginia.

pigra Bangs, a Southern race; smaller, darker, and with longer tail. T. l., Micco, Brevard Co., Fla.

---

[2] Pp. 146–49.

[3] P. 148.

[4] Journ. Mamm., Nov., 1923, p. 263.

[5] As above, May, 1924, p. 130.

marsupialis Linnæus, a dark form, with longer, blacker tail, and wholly black ears. Chiefly Mexican, but found in southwestern Texas. Appears in gray coat, and in black coat. Usually considered a quite distinct species, but not known to be different in habits. T. l., Northern Mexico, but the race *texensis* has Brownsville, Texas, for type locality.

HISTORY

The earliest notice I find of this creature is in Purchas' "Pilgrimages," 1616, where he describes the beasts of Virginia; and, among them, the Opossum, as follows:

"The Opassom, hath a head like a Swine, a tayle like a Rat, as big as a Cat, and hath vnder her belly a bag, wherein she carrieth her yong."[6] To which he adds on p. 1007, discussing the strange creatures of Nicaragua: "Another there is with a naturall purse vnder her belly, wherein she putteth her yong; it hath the bodie of a Fox, handed and footed like a Monkey."

Another quaint and early description appears in Baron Lahontan's Book, where he says: "The Ossa are little Animals like Hares, and resemble 'em in every thing, excepting the Ears and Hind-feet. They run, and cannot climb. Their Females have a Bag under their Belly, where their young ones enter upon a pursuit, in order to save themselves along with the Mother, who immediately betakes herself to flight."[7]

RANGE

This is the only species of Opossum occurring in the United States; for *marsupialis* is now considered to be merely a Southern form. It occupies all the wooded parts from Connecticut, Lake Ontario, southern Michigan, southern Wisconsin, Iowa, and eastern Nebraska, south to the Gulf Coast, west to the 100th meridian, through eastern Mexico and into the Tropics. It has recently been introduced in central California, as we shall see. Although scarce in the northern parts of its range, it is abundant and well known in Dixieland. These main facts are set forth on Map XVII (p. 639).

Ten years ago, I made another map which gave a much more restricted range. Except as a rare straggler, it was not then found north of Chicago, or east of the Hudson River. Ten years from now, a new map will be needed, for the Opossum is multiplying and spreading. It has solved the present problem of the high cost of living; and each year is adding to its range.

---

[6] Eighth Book, Chap. 5, § III, p. 945.

[7] New Voyages to North America, 1703, I, pp. 234–35.

RECENT RECORDS

Vermont. "A full-grown Opossum was caught by A. A. Roberts, a professional trapper, at Dorset, Vt., in the heart of the Green Mountains, in mid-December, 1920, long after the ground and streams had become frozen. The skin was seen by the writer."[8]

This same writer reports: "Another of the animals, a large male, was captured in a Fox trap late in October, 1921, at Mount Horrid, in Rochester, Vt., by Dexter W. Kathan, of Putney, Vt. The second animal was taken about 45 miles north of the scene of the first capture."[9]

New Hampshire. Dr. Francis Harper, of the Boston Society of Natural History, writes me, June 2, 1926: "Our taxidermist, Mr. John D. Smith, tells me that he caught a male in a Fox trap at Warner, N. H., on Dec. 10, 1910."

Massachusetts. In the Boston Society of Natural History Museum is a specimen taken at Newton Center, Mass., Feb. 15, 1925. This is recorded by Dr. G. M. Allen, in the Bulletin of the Society, April, 1925, p. 15.

Connecticut. At Cos Cob and Greenwich, during the last 20 years, I have seen over a dozen specimens taken, and have heard of many more. One or two of them I have kept in my menagerie. They are usually captured by Coon and Rabbit hunters, whose Dogs tree them at night. They were unknown 30 years ago.

Long Island. On Long Island, they are known to be abundant now. They were unknown there in primitive days, and were introduced by sportsmen quite recently; this is understood to mean in the '70's.

New York. "In the Highlands, the Opossum has always been fairly common since my boyhood; and hence, long before its too 'successful' introduction on Long Island, N. Y."[10]

Dr. C. H. Townsend says, in 1912: "The Possum is apparently extending its range northward. John Burroughs writes of finding it at West Park, N. Y., where it was previously unknown."[11]

Michigan. Norman A. Wood gives two records for Ann Arbor in 1912, and says: "These records are the 11th and 12th known to the writer from this county alone, and it is no doubt just as common throughout the southern part of the Lower Peninsula. We have records as far north as Ottawa, Genesee, and southern Isabella counties."[12]

---

[8] George L. Kirk, Rutland, Vt., Journ. Mamm., May, 1921, p. 109.

[9] As above, May, 1922, p. 115.

[10] Mearns, Fauna Hudson Highlands, Am. Mus. Nat. Hist., Sept. 9, 1898, p. 330.

[11] Making Friends, p. 23.

[12] Notes on Mich. Mamm., 14th Rep. Mich. Acad. Sci., 1912, p. 163.

In 1922, the same naturalist writes: "This species is rare in the county. One was taken by my father, Jessup S. Wood, in 1845, in Lodi Township. We have later records for Ann Arbor, Dexter, Manchester, Saline, and Scio Township. The last recorded specimen was taken by some boys in Nov., 1921, just south of the Oakland County line."[13]

Illinois and Wisconsin. "The Virginia Opossum is common in wooded localities in southern Illinois, and occurs sparingly in northern Illinois and southern Wisconsin."[14]

Iowa. Senator Lafayette Young of Desmoines, Ia., on the *Lusitania*, Feb. 1, 1915, told me that "Opossums are now common as far up as Desmoines. It first came about 10 years ago."

Saskatchewan. J. S. Charleson, of Brandon, Man., writes me, May 25, 1925, that an Opossum was caught by a boy, Reginald White, near Antler, Sask., about Christmas, 1924. He kept it alive for a short time in the stable. It was very thin, and died, apparently from starvation. Its weight was 4 pounds. Length, 29½ inches; tail, 10½ inches. It was a female. This specimen was mounted by Charleson, and is carefully preserved.

Colorado. Merritt Cary records the taking of one near the head of Caddoa Creek in the winter of 1903–04. Full details are given in his Biological Survey of Colorado, *N. A. F.*, 33, 1911, pp. 52–53.

The Possum in California

The introduction of the Opossum into California was apparently the result of accident. But the creature has thriven, and is spreading rapidly, like most foreigners in California.

It has appeared in two widely separated localities—one, in and about Santa Clara, near San Francisco, and the other, about Los Angeles. In the first region, they are known to have been introduced. They may also have been introduced in the South, but at present, no evidence is at hand to prove it.

In 1906, the species was first taken near Whittier, Los Angeles Co. With increasing frequency, others were captured in the region.[15]

In Ventura Co., the creature was plentiful in 1924.[16]

The northern implantation is better known. In 1910, J. R. Kocher, a jeweller in San José, imported from Tennessee, 7 Possums, of which 5 escaped. Other captives are believed to have escaped later. They have spread rapidly, and are now reported from the following counties: Santa Clara, San Mateo, San Benito, Amador, Alameda, Tulare, as well as Los Angeles and Ventura.

---

[13] Mamm. of Washtenaw Co., Mich., Univ. of Mich., July 10, 1922, p. 5.

[14] C. B. Cory, Mamm. Ill. & Wis., p. 52.

[15] Etta V. Little, Cal. F. & G., Jan., 1916, pp. 46–47.

[16] George P. Austin, Oxnard, Calif., Cal. F. & G., Jan., 1924, p. 46.

Joseph Grinnell writes:[17] "It is believed that fully 200 Possums are accounted for to the present date, as killed or captured; and in spite of this, the species appears to be spreading and multiplying at a rapid rate.

"It would appear that the Possum has found in this part of California congenial climatic conditions, at least sufficiently near those of its native habitat in the southeastern United States so that it is thriving. It is rather doubtful if we are to consider ourselves lucky in having acquired this addition to our mammal fauna. In fact, it is quite possible that we may live to greatly regret the circumstances which secured its introduction into our State."

HAUNTS

There are three essentials to make a Possum paradise—food, woods, and water. All its far-flung searching parties have followed the rivers through more or less timber. Where the timber ceases, or the water ends, the Possum halts its onward march.

Rocky uplands are not to its taste, but a swamp it loves; and where there are hollow trees near by for lodging, the Possum is content to take a chance on the food question.

One other limitation, of course, is observed: This haunt must not be farther north than the north edge of the Alleghanian Fauna.

NUMBERS

Hundreds of men have spent their lives in Possum country, and yet have never seen a live, loose Possum. The creature is so strictly nocturnal, and so secretive, that it is seldom found till trapped, or else treed by some night-roving Dog.

Bachman, by offering rewards to the darkeys about his South Carolina home, was able to secure 35 alive in three nights.[18] Half a dozen were frequently taken in a single night hunt in the old plantation days.[19] He calls it a "very abundant species," in South Carolina.[20]

Bailey says the Possums in Texas were "more or less abundant throughout their range."[21] James H. Gaut "found them abundant in the Big Thicket northeast of Sour Lake [Texas"].[22] They are rather a nuisance to the trapper of the region, because they continually get into the traps set for more valuable game.

---

[17] George P. Austin, Oxnard, Calif., Cal. F. & G., April 10, 1915, pp. 1–3.

[18] Q. N. A., II, p. 119.

[19] As above, p. 115.

[20] As above, p. 119.

[21] Texas, p. 56.

In Jersey, the species is general, but not abundant, according to various accounts.

It is probably now as plentiful as ever it was in Dixieland; yet we have no means of estimating its numbers.

Home Range

Almost as slow as a turtle, seems the woolly Roasting-pig, so that we should expect it to have a very limited home range.

Bachman says: "Although a slow traveller, the Opossum, by keeping perseveringly on foot during the greater part of the night, hunts over much ground; and has been known to make a circle of a mile or two in one night. Its ranges, however, appear to be restricted or extended, according to its necessities; as when it has taken up its residence near a cornfield, or a clump of ripe persimmon trees (*Diosperos virginiana*), the wants of nature are soon satisfied; and it early and slowly carries its fat and heavy body to its quiet home, to spend the remainder of the night and the succeeding day in the enjoyment of a quiet rest and sleep."[23]

The Tail

The Possum is the only animal on our list that can hang by its tail. There are a few in Australia and one or two in the Old World that are blessed with this fifth hand; the great body of them are in South America, where swinging by the tail is a specialty. But the only tail-hanger that crosses the Mexican border into the United States, is the homely, humping, sluggish, stupid Possum.

The strength and service of this "little behind hand" seem to be greater than those of any one of its feet; for it can hang by the tail while its body and legs swing free. "In this manner," says Bachman, "we have observed it gathering persimmons with its mouth and forepaws, and devouring them whilst its head was downwards and its body suspended in the air; holding on sometimes with its hind feet and tail, but often by the tail alone."[24]

Personally, I have always been disappointed when I tried to make a Possum perform with its tail. I never saw one hang by it, or show any clear consciousness that it had such a member.

---

[22] Texas, p. 57.

[23] Q. N. A., II, p. 111.

[24] As above, p. 111.

However, Dr. Townsend writes, concerning a captive which he observed: "We discovered by experiment that he can hang by the tail perfectly, provided that at least half of the tail has hold of the branch, and that the branch is thick enough. There is not enough grip in the extreme end of the tail to support his weight; and the tail is too thick for a perfect grasp if the branch is slim."[25]

An entirely new observation on the use and power of the tail is supplied by Leon L. Pray of the Field Museum. Describing the habits of a caged Opossum, he says:

"When the fall days began to grow cold, I gave this fellow a thick carpet of autumn leaves in his box cage. Though he ate heartily of meat scraps, fruits and vegetables, he was not contented. When not sound asleep in his favourite corner, he pounded solemnly around and around his cage like a wild Tiger, with a funny, preoccupied look on his grinning face.

"One morning, when I glanced into his cage I was surprised to see him pacing around his beat with a large bunch of leaves tightly rolled up in his long, prehensile tail. He carried this bundle so long, around and around in tireless pace, that I left him without learning the object of his action. Later he repeated this carrying of a bundle of leaves in his tail a number of times. I noticed that he had made a half-hearted attempt to build a nest in one corner; but had abandoned the idea, and slept anywhere that he happened to be when drowsiness overcame him.

. . . .

"The accompanying sketch shows accurately the manner in which the tail was employed in carrying bundles of leaves."[26] (Plate CXI, p. 883.)

DEN

The home of the Possum is a hole--anywhere—in anything—high or low—so it be a hole that is dry and warm, not far from timber, and handy to water.

Bachman says: "This animal is a tolerable digger, although far less expert in this quality than the Maryland Marmot. Its den is usually under the roots or stumps, when the ground is so elevated as to secure it from rains and inundations. The hollow of a large fallen tree, or an opening at the roots of a standing one, also serve as a convenient place for its nest. . . . On firing into a Squirrel's nest which was situated in the fork of a tree some 40 feet from the ground, we brought down an Opossum, which had evidently expelled its legitimate occupant.

---

[25] Making Friends, p. 23.

[26] Journ. Mamm., May, 1921, pp. 109–10.

"The Florida Rat is known to collect heaps of sticks and leaves, and construct nests sometimes a yard in diameter and 2 feet high; these are usually placed on the ground, but very frequently on the entangled vines of the grape, smilax, and supple jack (*Ziziphus volubilis*). In these nests, an Opossum may occasionally be found, dozing as cozily as if he had a better right than that of mere possession."[27]

They have been found sleeping in hollow trees, hollow logs, holes in the ground, in thickets, curled up on the leaves, perched in high crotches of trees, under logs or woodpiles about buildings, in barns, under floors, in drain pipes—every possible shelter, with every possible variation dictated by the weather.

The lining of the nest is a matter of importance, for the "woolly Shoat" loves its comfort. Bachman says: "The material which we have usually found composing this nest along the seaboard of Carolina, is the long moss (*Tillandsia usnoides*); although we have sometimes found it composed of a bushel or more of oak and other leaves."[28] This is carried in by the tenant. The manner of collecting and transporting the bedding had never been observed, until the account by Leon L. Pray furnished very unexpected light.

So far as known, the female alone regulates the home.

Mating, Gestation, and Breeding

Whether the Possum pairs or is promiscuous, no one knows. Usually the female is found alone with the brood. If anyone reports definitely and in detail, the presence of a male with a female during the time the young are in the pouch, it will at least be evidence pointing toward monogamy.

The breeding of the Opossum has been made the subject of more fairy tales and fantastic explanations than any other perfectly simple natural process discussed in this work. Because the male organ happens to be forked, it was assumed that the nostrils, not the sex-organ of the female was the receptable of the "pollen." Because the young are exceedingly small prior to birth, it was stated that no man had ever found them *in utero*. Because they were found in the mother's pouch, it was supposed that she blew them there out of her nose, etc., etc.

The whole process of copulation and reproduction is as in other quadrupeds—except in one important particular. Most of our young animals are raised at the breast, and cuddled in the mothers' arms. But in the Possum it is otherwise; its babies look like abortions—born too soon; they are never mother-cuddled; and every little Possum is an incubator baby.

---

[27] Q. N. A., II, p. 113.

[28] As above.

The earliest careful investigator of these happenings in Possum life was Bachman himself. His account impresses us, not only with the strangeness of the Possum babyhood, but also with the lifelong patience and unbounded opportunities with which Bachman himself was blessed.

He was the first naturalist to discern and report on the young *in utero*.

"We have been so fortunate," he says, "in 5 instances, as to have procured specimens in which the young were observed in this position; and therefore feel prepared to speak with certainty. We are not aware that the young of the Virginian Opossum had been previously detected in the uterus."[29]

Next he set about ascertaining the time of giving birth.

"We ascertained, by having a number of females procured with young in their pouches, that about the close of the first week in March—a little earlier or later, according to the age of the individual, or warmth, or coldness, of the previous winter—was the time when, in this latitude, this event usually occurs. Here, however, another difficulty presented itself, which for several successive seasons, thwarted us in our investigations. In the third week of February, 1847, by offering premiums to the servants on several neighbouring plantations, we obtained in 3 nights, 35 Opossums, but of that number, there was not a single female. A week afterwards, however, when the young were contained in the pouch, we received more females than males.

"From this circumstance we came to the conclusion that during the short period of gestation, the females, like those of some other species of quadrupeds—particularly the American Blackbear—conceal themselves in their burrows, and can seldom be found."[30]

From these and other observations, he decided that 15 days was the period of gestation. But Professor Hartman points out the difference between copulation and ovulation; then says: "I have accumulated considerable data on the rate of development, that leads me to believe that 12 to 13 days is very nearly correct for this period (gestation)."[31]

BROODS

Since broods have been found from January to July, and it takes 2 months for the young to reach self-sufficiency, it is commonly stated that three broods each season are the rule, at least in the South. But such an inference gives the mother no rest time between broods. Fuller investigation may prove that, except in the dark days of November and December, young are born the year round, but the same mother does not bear them so continuously.

---

[29] Q. N. A., II, p. 119.

[30] As above.

[31] Œstrous Cycle in the Opossum, Am. Journ. Anat., Vol. 32, No. 3, Nov., 1923, p. 366.

Probably two broods per season for each mother is the rule in the South, and in the Northern States, but one.

One of the most interesting observations showing that a new brood may arrive while yet the first have need of the mother's care, is given by Bachman as follows:

"We consider the early parts of the three months of March, May and July, as periods in South Carolina when they successively bring forth; it is even probable that they breed still more frequently, as we have observed the young during all the spring and summer months. In the month of May, 1830, whilst searching for a rare species of *coleoptera*, in removing with our foot some sticks composing the nest of the Florida Rat, we were startled on finding our boot unceremoniously and rudely seized by an animal which we soon ascertained was a female Opossum. She had in her pouch 5 very small young, whilst 7 others about the size of full-grown Rats were detected peeping from under the rubbish."[32]

YOUNG

"The young, when first born," says Bachman, "are naked and flesh-coloured; the eyes, together with the ears, are covered by a thin integument through which these organs and the protuberances of the ears are distinctly visible. The mouth is closed, with the exception of a small orifice, sufficiently large to receive the teat, which is so thin and attenuated that it seems no larger than the body of a pin. Length of body, $\frac{7}{12}$ of an inch; of tail, $\frac{2}{10}$. The nails, which can [not] be seen with the naked eye, are very distinct when viewed with a microscope, and are of a dark brown colour, small and much hooked. The nostrils are open; the lungs filled with air; and when placed in water, the young float on the surface.

"The number of young usually found in the pouch appear to be less than those that are born. The highest number we have found in the pouch was 13, the smallest, 6; whereas the preserved uterus brought to us by Mr. Fisher, contained 15. In all such cases, where a greater number of young are produced than there are teats, the last of the brood must inevitably perish, as those that are attached appear incapable of relinquishing their hold.

"The manner in which the young at birth reach the pouch, and become attacned to the teats, has been the subject of much speculation and inquiry. We had an opportunity of examining this process in part, without, however, having been aware at the time that it was going on. We intended to dissect a small female Opossum, which had been a few days in our possession; but ascertained in the morning at 7 o'clock on the day our examination was to have been made, that she had 3 young in her pouch; supposing from her small size, that she would produce no additional number, we concluded to spare her life. She was confined in a box in our study; when we occasionally looked at her, we found her lying on one side, her shoulders elevated, her body drawn up in the shape of a ball; the pouch was occasionally distended with her paws in this position the parts reached the edge of the pouch; she was busily employed with her nose and mouth licking, as we thought, her pouch, but in which, we afterwards ascertained, were her young.

---

[32] Q. N. A., II, p. 124.

"At 6 o'clock in the afternoon, we were induced to examine her again, in consequence of having observed that she had for several hours appeared very restless, when we discovered that she had added 4 more to her previous number, making her young family now to consist of 7. With no inconsiderable labour and the exercise of much patience, we removed 3 of the young from the teats, one of which perished under the process, we replaced the 2 living ones in the pouch; at 9 o'clock examined her again and found both the young once more attached. We came to the conclusion that she shoved them into the pouch, and with her nose or tongue moved them to the vicinity of the teats, where by an instinct of nature, the teat was drawn into the small orifice of the mouth by suction. We observed subsequently that a young one that had been extracted from its parent a few moments before the time when it would have been born, and which had been rolled up in warm cotton, was instinctively engaged in sucking at the fibres of the cotton, and had succeeded in drawing into its mouth a considerable length of thread."[33]

Very good, so far as it goes; quite correct in observation; faulty only in the inference. The honour of discovering the missing link in the chain of interesting events was reserved for Prof. Carl Hartman of the State University of Texas (now of Johns Hopkins, Baltimore), from whose valuable papers on Possum Reproduction (see References) I quote extensively as follows:

How They Reach the Pouch

"A series of observations and experiments during the last four or five breeding seasons of the Opossum, has enforced the conviction that the young reach the pouch and find the teat by their own efforts, and are not placed on the teats by the mother's tongue or lips. . . .

---

[33] Q. N. A., II, pp. 121–22.

"On several occasions, I experimented with newly-born pouch-young, gently removing them from the teats to which they had firmly attached themselves by means of their powerful tongues. I quote from my notes in one case. . . .

"'Female tied down, and pouch opened. Young which were removed from teats, crawled about, moving hands alternately, as in swimming. Were able to crawl among hairs, and find teats by their own efforts. One specimen, removed three times, found teat each time; and 3 others found teats after wandering about.'

"These experiments certainly argued strongly in favour of some little independence of action on the part of these 'embryos,' a term that Dr. [Charles D.] Meigs would have us abandon when speaking of these 'breathing, sanguiniferous, digesting pouch-young.'"

On Feb. 6, 1917, while Hartman was examining a female under anæsthesia, the young were expelled. "They were mostly still alive," he says, "entangled in fœtal envelopes, and immersed in the fœtal liquid. To some of the fœtuses, the umbilicus was still attached; others were free, but no navel could be seen in any case. None of the fœtuses, even after being freed of membranes and liquids, could crawl about, as they were apparently drowned in their own embryonic fluid. It seemed likely, therefore, that the embryos, on emerging from the vagina, need the assistance of the mother to lick away the fluid expelled from them; and this was later verified by actual observation."[34]

The Birth of a Brood

Hartman continues: A specimen "was brought to the laboratory, Feb. 2, 1920, having been captured uninjured several nights before. She was a healthy female of medium size. . . . I recognized her as pregnant, and likely to give birth within several days. . . .

"At 10.30 P. M., Feb. 6, 1920, the animal showed signs of restlessness, and soon began cleaning out the pouch, which she did about four times. Then began a short series of spasmodic contractions of the abdominal wall, after which she came to a sitting posture with legs extended. . . .

"After assuming the sitting posture, our specimen bent her body forward, and licked the vulva; however, her position at this time was such that we could not see the embryos, which very likely passed into the pouch with the first licking of the genital opening. Hence, we went to the outside where we could plainly hear her lap up the chorionic fluid; then suddenly a tiny bit of flesh appeared at the vulva, and scampered up over the entanglement of hair into the pouch, to join the other fœtuses, which now could be seen to have made the trip without our having observed them. Unerringly, the embryo travelled by its own efforts. Without any assistance on the mother's part, other than to free it of liquid on its first emergence into the world, this 10-day-old embryo, in appearance more like a worm than a mammal, is able, immediately upon release from its liquid medium, to crawl a full 3 inches over a difficult terrain. Indeed, it can do more: after it has arrived at the pouch, it is able to find the nipple amid a forest of hair. This it must find—or perish."

---

[34] Studies, 1920, pp. 252–53.

On fuller examination, he found that "the pouch contained a squirming mass of 18 red embryos, of which 12 were attached, though 13 might have been accommodated. The remainder were, of course, doomed to starvation. Even some of these unfortunates, however, held on with their mouths to a flap of skin, or to the tip of a minute tail, while several continued to move about.

"With the mother under the influence of ether, we now gently pulled off a number of embryos from the teats in order to test their reactions. The teats had already been drawn out from about a millimeter in height to double that length, doubtless by the traction of the embryo itself, for the bottom of the pouch certainly presented a busy scene with each member of the close-pressed litter engaged in very active breathing and sucking movements.

"One detached young, placed near the vulva, crawled readily back into the pouch. Two or three others regained the teats after some delay; and one wanderer, which lost out in the first scramble, found a vacated teat and attached itself even after 20 minutes' delay showing that the instinct to find the teat persists for some time. If the skin be tilted, the embryos can be made to travel upward and even away from the pouch, for they are negatively geotropic.

"For locomotion, the embryo employs a kind of 'overhand stroke,' as if swimming, the head swaying as far as possible to the side opposite the hand which is taking the propelling stroke. With each turn of the head, the snout is touched to the mother's skin as if to test it out; and if the teat is touched, the embryo stops, and at once takes hold.

"It is thus apparent that the Opossum embryo at birth possesses not only fairly well-developed respiratory and digestive systems, but that it has attained a neuro-muscular development sufficient to enable it to find its place in the pouch where food and shelter await it."[35]

---

[35] Studies, 1920, pp. 254–56.

Number of Pouch Young

According to numberless observers, 6 or 7 is the usual number of young found in the pouch. Nevertheless, as Hartman says, "most female Opossums possess 13 teats, of which usually only the posterior 11 are functional. I have often found as many as 11 pouch young attached; but only in 2 cases, as many as 12. Doctor Meigs, on one occasion, found 13. I have seen litters consisting of 15, 17, and 18 newly-born young in the pouch, with as few as 7 attached to teats; and have removed from pregnant uteri as many as 22 normal fœtuses near term."[36] That is, half of the brood are early doomed to perish—maybe on their first day. This illustrates the reckless slaughter of innocents that we continually find in nature—the remorseless selection of the strongest to perpetuate the race.

A remarkable exception to the rule of small broods is furnished by Bailey, who records that a Possum he sent to the National Zoo, Aug. 28, 1917, was found to have 17 young, probably several weeks old, which had just emerged from the pouch.[37]

The Young in Mother's Care

The growth of the young is surprisingly rapid. Bachman tells of unborn but near-full-term young, taken Feb. 14, 1848, each weighing $2\frac{1}{2}$ grains; others taken Feb. 18th, weighed 3 grains. After citing other cases of even greater weight, he thus summarizes: "The weight, then of the young Opossum at the moment of birth, is between 3 and 4 grains."[38]

"We weighed the largest young one," he says, "at a week old, and found that it had increased from $3\frac{3}{4}$ grains to 30 grains. Length of head and body, exclusive of tail, $1\frac{1}{4}$ inch; tail, $\frac{1}{2}$ inch. The young at this age are very tenacious of life; as on removing 2, they remained alive on the floor without any covering through a cool night, in a room containing no fire; and still exhibited a slight motion at 12 o'clock on the following day.

"The teats of the mother after the young had been gently drawn off measured an inch in length, having been much distended, and appeared to have been drawn into the stomach of the young. The pouches of the young females were quite apparent; they used their prehensile tails which could now be frequently seen entwined around the necks of others. At 12 days old, the eyes were still closed, a few hairs had made their appearance on the moustache; the orifices of the ears were beginning to be developed, and the nails were quite visible and sharp.

---

[36] Studies, 1920, p. 256.

[37] Mamm. D. C., Proc. Biol. Soc. Wash., May 1, 1923, p. 106.

[38] Q. N. A., II, p. 120.

"When the young are 4 weeks old, they begin from time to time to relax their hold on the teats, and may now be seen with their heads occasionally out of the pouch. A week later and they venture to steal occasionally from their snug retreat in the pouch; and are often seen on the mother's back, securing themselves by entwining their tails around hers. In this situation she moves from place to place in search of food, carrying her whole family along with her, to which she is much attached, and in whose defense she exhibits a considerable degree of courage, growling at any intruder, and ready to use teeth with great severity on man or Dog.

"In travelling, it is amusing to see this large family moving about. Some of the young, nearly the size of Rats, have their tails entwined around the legs of the mother, and some around her neck; thus they are dragged along. They have a mild and innocent look, and are sleek, and in fine condition; and this is the only age in which the word 'pretty' can be applied to the Opossum. At this period the mother, in giving sustenance to so large a family, becomes thin, and is reduced to one half her previous weight.

"The whole family of young remain with her about 2 months, and continue in the vicinity till autumn. In the meantime, a second and often a third brood is produced, and thus 2 or more broods of different ages may be seen, sometimes with the mother, and at other times not far off. . . .

"The female produces young at a year old. The young born in July do not bring forth as early as those born in March, but have their young as soon as the middle of the succeeding May."[39]

VOICE

So far as recorded, the Possum is one of the most silent of our animals. It has no call note, no note of recognition or of anger, except at rare times a low growl; or occasionally a faint hissing, when, with mouth wide open, it views the approach of a stranger.

Nevertheless all this is but the casual and superficial observation of persons who have had but fleeting glimpses of the creature under circumstances when its evident policy was to keep quiet. Some day our younger and more minutely observant naturalists will tell us of its extensive list of sounds, with calls to mate or young ones--yes, even a love-song for the love-time. Has it not vocal apparatus and strongly marked instincts and desires that need expression? From this we may argue that—just as surely as sundry planets have been predicted because of their inevitability—the Possum will be shown to have a voice and a vocabulary, all his own.

---

[39] Q. N. A., II, pp. 123–24.

Gait—Waddle and Swing

About 40 years ago, I saw my first Possum. It was dead, and had been brought me as material for a drawing. "But," I said to my friend, "I never saw one alive. I don't know whether it's an active, alert thing like a Squirrel, leaping from bough to bough, or a slow, cautious thing like a Coon." The answer was, "It's just the slowest, stupidest, crawlingest thing that ever was in the woods, and it's like nothing but itself."

On the ground "the gait of the Opossum is slow, rather heavy and awkward," as Bachman says. "It is not a trot like that of the Fox, but an amble or pace, moving the two legs on one side at a time. Its walk on the ground is plantigrade, resting the whole heel on the earth. When pursued, it . . . goes forward at a rather slow speed . . . never . . . increasing it to a leap or canter, but striving to avoid its pursuers by sneaking off to some thicket or briar patch. When, however, it discovers that the Dog is in close pursuit, it flees for safety to the nearest tree, usually a sapling; and unless molested, does not ascend to the top, but seeks an easy resting place in some crotch not 20 feet from the ground where it waits silently and immovably, till the Dog, finding that his master will not come to his aid, and becoming weary of barking at the foot of the tree, leaves the Opossum[40] to live its own life.

The Low-brow Possum

As to intelligence, most observers agree that the Opossum has none. It is a silly grinning idiot.

Bailey, by using beans, measured a Possum brain-pan to compare its equipment with that of a similar-sized Coon. The Possum's wit-box held but 25 beans, while that of the Coon held 150; i. e., the latter had 6 times as much gray matter as the Possum. (See Plate CXI, p. 883.)

Measuring by the same standard, I got the following results: Possum, 21 beans; Skunk, 35; Arctic Hare, 46; Hog-nosed Skunk, 50; Porcupine, 70; Kitfox, 120; Redfox, 198; Coyote, 325; while the Gray-wolf rejoices in a brain of 438 bean-power. Of course, this gauge is not perfect, as it takes no account of the larger size of the last two.

The Possum is the most hopeless fool of the woods. It will enter any kind of trap, no matter how often it has previously suffered from such contrivances; and when caught by some hard-gripping steel, it has not wits enough

---

[40] Q. N. A., II, p. 110.

PLATE CIX.—POSSUM UP A TREE

From drawing by E. T. Seton in collection of N. Y. Zoological Society

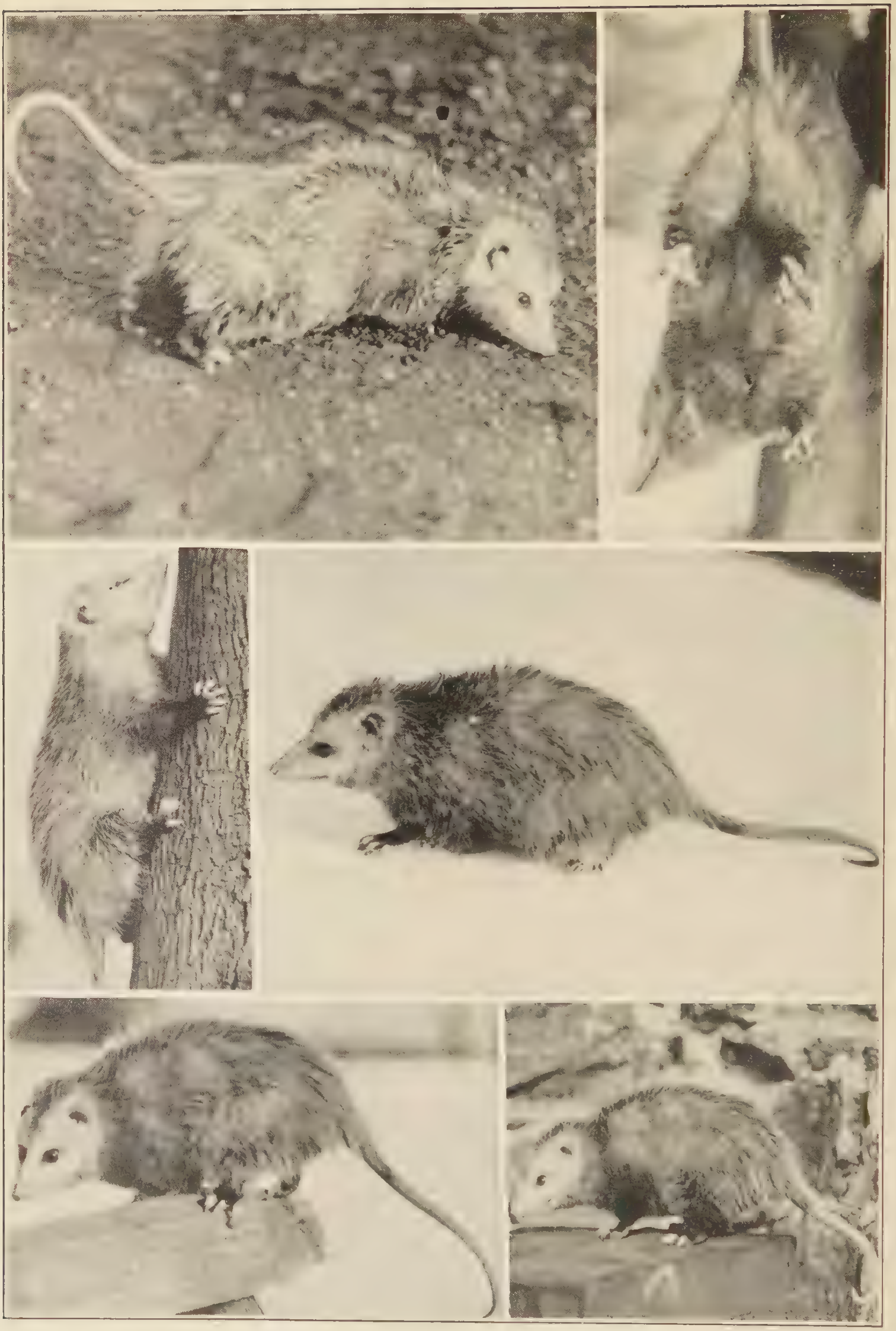
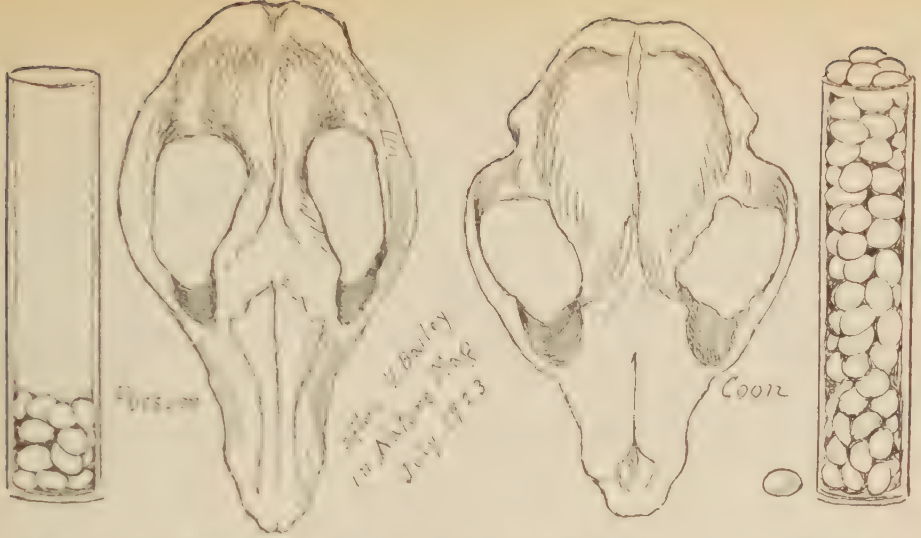
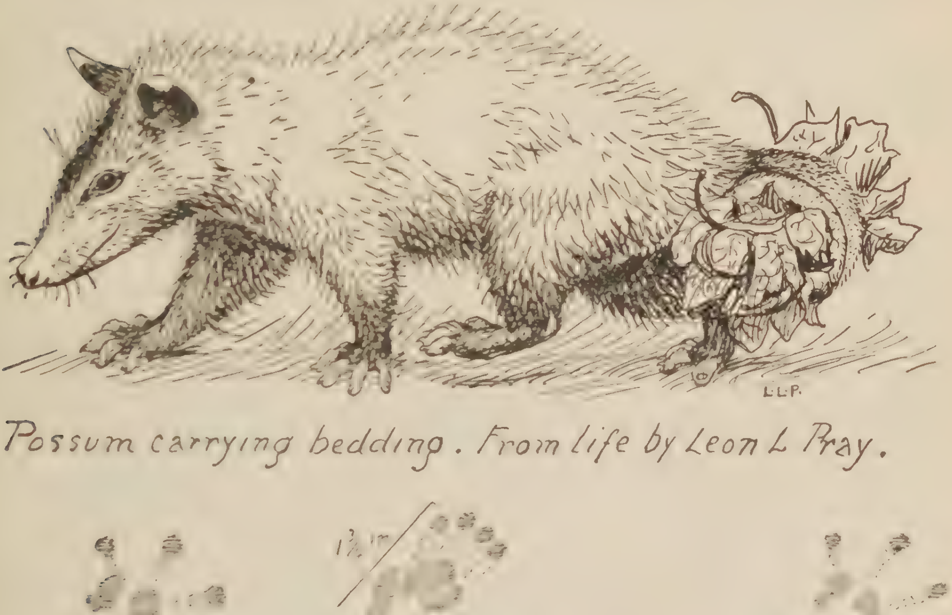


PLATE CX.—POSSUM POSES

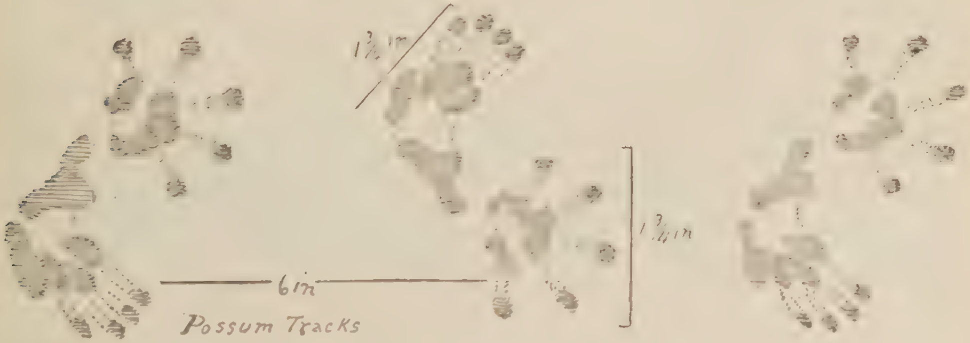
By E. T. Seton



Showing relative brain capacities — Possum 25 beans — Coon 150 beans



Possum carrying bedding. From life by Leon L Pray.



Possum Tracks

PLATE CXI.—DETAILS OF POSSUM

even to get mad; it simply looks bored, scared, and non-resistant. We find in this a melancholy proof that, in the struggle for life, wits count for less than fecundity—a complete, logical application of which principle warns us that Europe will be wiped out by Asia, and the proud blood of America by the teeming, proletariat Wop. And shall I add a sinister and disquieting thought? This world-winner is a pacifist.

Bailey caught a female in one of his trapping trips in Texas. She "showed no disposition to fight or defend herself." But he was reminded that there are exceptions even to Possum pacifism, for "an old male, caught a day or two later, fought viciously, growling, and biting anything that came within reach, actually cutting deep gashes in the hard-wood stock of my gun."[41]

BEHAVIOURISTIC DETAILS

Solitary. The Possum is a strictly solitary animal; no one has yet reported two adults together, even during the breeding season.

During summer, it is common to find an old Opossum and a lot of smaller ones in the same den; but these, of course, are her young, and, by this time, they are three-quarters grown. In the autumn, they usually separate, and each goes forth alone to seek his fortune.

A Surprise. Mrs. M. D. Bakewell, sister-in-law of the great Audubon, has sent me in a personal letter from Pewee Valley, Ky.,[42] the following delightful incident which seems to contradict the above rule:

"A relative of mine, Mr. Thomas Kennedy, living on a farm near Louisville, had an old-time slave cook called Aunt Mimy. She reigned queen in her cabin kitchen outside, as was the way in old times. One cold winter, she had a pet Possum, which abided behind the stove in a box of rags, a favourite form of upholstery with our country darkeys. The weather became intensely, exceptionally cold. All of a sudden, the pet Possum left his warm quarters; and, as days passed by without his return, Aunt Mimy grieved for him as one of the 'loved and lost.'

"After he had been gone for about a week, she heard a little scratching on her kitchen door, and when she opened it, there was her Possum come back—and behind him was a train of 9 of his brethren. He led them straight round behind the stove, whither, no doubt, he had invited them by glowing accounts of the warmth and hospitality of that spot. Who now can doubt his power of language?"

---

[41] Texas, p. 58.

[42] Oct. 3, 1902.

A NIGHT PROWLER

"Like the great majority of predacious animals," says Bachman, "the Opossum is nocturnal in its habits. It suits its nightly wanderings to the particular state of the weather. On a bright starlight or moonlight night, in autumn or winter when the weather is warm and the air calm, the Opossum may everywhere be found in the Southern States, prowling around the outskirts of the plantation, in old deserted ricefields, along water courses, and on the edges of low grounds and swamps; but if the night should prove windy or very cold, the best-nosed Dog can scarcely strike a trail."[43]

PLAYING POSSUM

Many animals and many insects "play Possum." It is a well-known pacifist trick; but none other than the present creature, has made such a profound, lifelong, and successful study of the ruse which, in accordance with the established custom of science, has been named for its chief exploiter.

"The habit of feigning death," says Bachman, "to deceive an enemy, is common to several species of quadrupeds; and we, on several occasions, witnessed it in our common Red-fox (*V. fulvus*). But it is more strikingly exhibited in the Opossum than in any other animal with which we are acquainted. When it is shaken from a tree and falls among grass and shrubbery, or when detected in such situations, it doubles itself into a heap, and feigns death so artfully, that we have known some schoolboys carrying home for a quarter of a mile an individual of this species, stating that when they first saw it, it was running on the ground, and they could not tell what had killed it. We would not, however, advise that the hand should, on such occasions, be suffered to come too familiarly in contact with the mouth, lest the too curious meddler should on a sudden be startled with an unexpected and unwelcome gripe."[44]

Similarly Nelson says: "They are rather slow-moving, stupid animals, which seek safety by their retiring nocturnal habits, and by non-resistance when overtaken by an enemy. This last trait gave origin to the familiar term 'playing Possum,' and is illustrated by their habit of dropping limp and apparently lifeless when attacked. Despite this apparent lack of stamina, their vitality is extraordinary, rendering them difficult to kill.

"While hunting at daybreak, I once encountered an unusually large old male Opossum on his way home from a night in the forest. When we met,

---

[43] Q. N. A., II, p. 110.

[44] As above, p. 116.

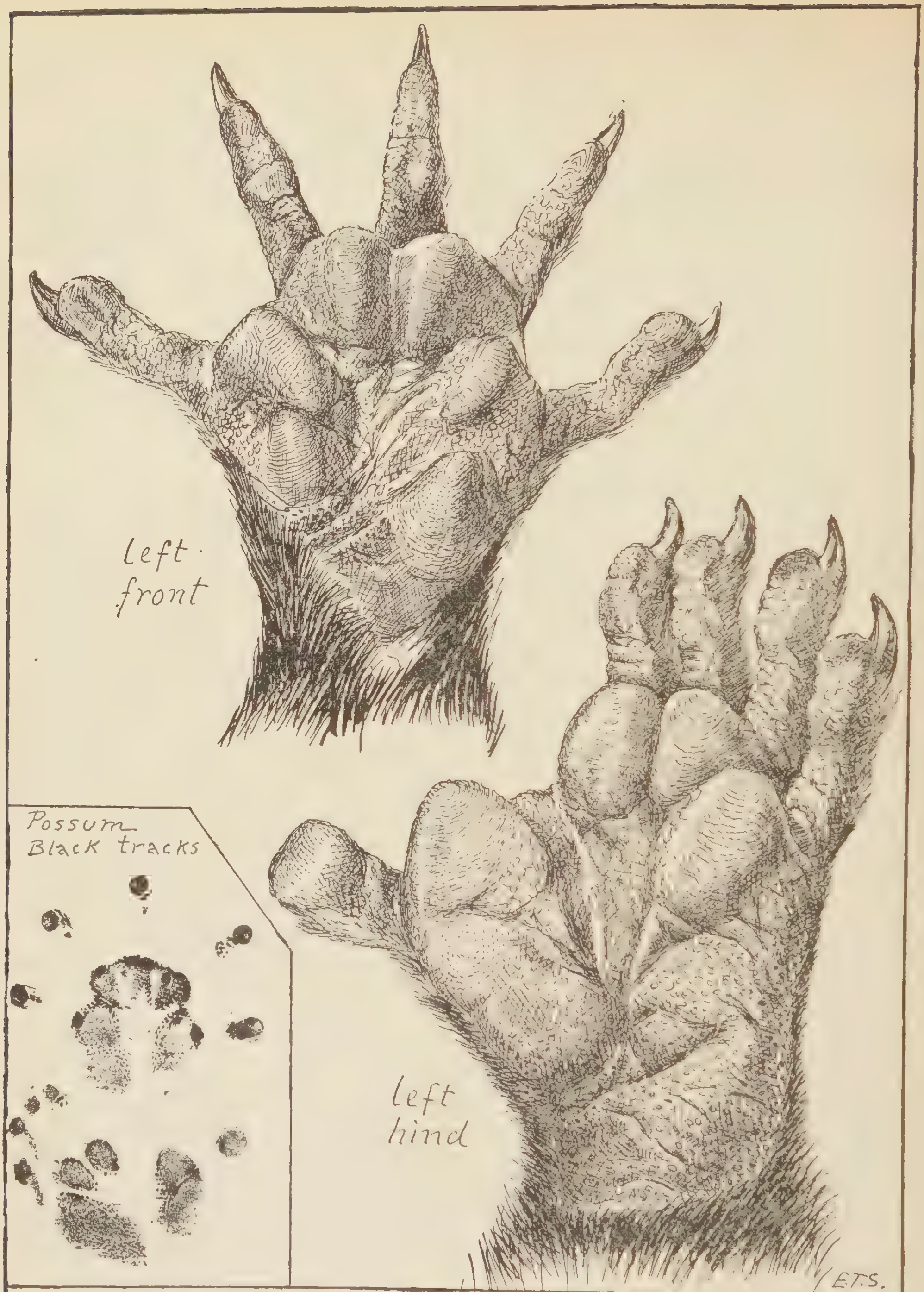


Plate CXII. Paws of Possum nearly twice life size he immediately stopped and stood with hanging head and tail, and half-closed eyes. I walked up, and, after watching him for several minutes without seeing the slightest movement, put my foot against his side, and gave a slight push. He promptly fell flat, and lay limp and apparently dead. I then raised him, and tried to put him on his feet again, but his legs would no longer support him, and I failed in other tests to obtain the slightest sign of life." [45]

DOMESTICATION

It is evidence of servility rather than of brains in an animal, when it submits readily to domestication. Many naturalists have had tame Possums. One of the earliest was Bachman's. He says:

"The Opossum is easily domesticated when captured young. We have, in endeavouring to investigate one of the very extraordinary characteristics of this species, preserved a considerable number in confinement, and our experiments were continued through a succession of years. Their nocturnal habits were in a considerable degree relinquished; and they followed the servants about the premises, becoming troublesome by their familiarity and their mischievous habits. They associated familiarly with a Dog on the premises, which seemed to regard them as necessary appendages of the motley group that constituted the family of brutes in the yard. They devoured all kinds of food: vegetables, boiled rice, hominy, meat both raw and boiled, and the scraps thrown from the kitchen; giving the preference to those that contained any fatty substance." [46]

"On one occasion a brood of young with their mother made their escape, concealed themselves under a stable, and became partially wild; they were in the habit of coming out at night, and eating scraps of food, but we never discovered that they committed any depredations on the poultry or pigeons. They appeared, however, to have effectually driven off the Rats, as during the whole time they were occupants of the stable, we did not observe a single Rat on the premises."[47]

Dr. Charles H. Townsend's tame Possum has furnished a number of interesting facts. Townsend turned the creature loose in his office after commenting on its slow cautious movements, he says:

"Our Possum never exhibited unseemly haste; he had time and to spare. Day after day he crouched on the shelf, as I went on with my noiseless work, but the slightest sound or jar gave him a nervous start: a sneeze or the striking of a match really disturbed him. His rations, placed on the shelf before him, were at first disregarded, until there was complete silence, when he would be discovered eating with an energy that savoured little of Possum playing. Later on he gained confidence and became tamer.

---

[45] Wild Animals of North America, 1918, p. 408.

[46] Q. N. A., II, p. 117.

[47] As above.

. . . .

"Waiting for a Possum to do something interesting was evidently a matter of more time than I had to spare; so he was swung by the tail on to a shelf near to the window, and just across the room from my desk, where if he ever did anything, I should be a witness. Nothing happened for an hour, when I placed a quarter of an apple under his nose and resumed my work.

"After about 10 minutes, hearing a slight sound, I looked up to see the Possum holding the apple quarter in one hand, and rapidly but thoroughly chewing a mouthful. When the apple was finished, he settled back somewhat on his haunches, and proceeded to wash his face cat-fashion, only he used both hands at once, licking his lips and fingers and then rubbing his nose and cheeks.

"After that, nothing happened for half an hour, when I went over and stroked his back. This caused nervousness and a silly display of his teeth, but he crouched and submitted. No attempt was made to leave the shelf, and in the evening, the Possum was shut in an empty room just to make sure he wouldn't be abroad at night, after the fashion of Possums.

"He was always treated gently, unless carrying by the tail be rough treatment, but the Possum's tail is strong, and is such a safe handle when there are open jaws at the other end of the animal, that there is no other logical method. Besides, he sometimes suspends himself by it."[48]

FOOD

When one has an omnivorous animal (such as the Possum) in a country of unlimited food supplies (such as America), it is easier to list the foods it refuses than those it accepts. While every bird, beast, reptile, frog, fish, insect, fruit, nut, root, berry, and carrion are accounted "clean" in the Possum's code, it has definite preference for chickens, eggs and persimmons; a definite indifference to Horse and Cow feed, such as hay, oats, and grass; and is rarely known to be guilty of cannibalism.

Bachman is again to the fore as a Possum authority when its food is to be considered. Beginning by saying that the Possum possesses an appetite for nearly everything eatable, he continues, "It enters the cornfields (maize), crawls up the stalks, and sometimes breaks them down in the manner of the Raccoon, to feed on the young and tender grains; it picks up chestnuts, acorns, chinquapins, and beech nuts, and munches them in the manner of the Bear. We have, on dissection, ascertained that it had devoured blackberries, whortleberries, and wild cherries, and its resort to the persimmon tree is proverbial. It is also insectivorous, and is seen scratching up the leaves in search of worms, and the larvæ of insects, of which it is very fond. In early spring, it lays the vegetable kingdom under contribution for its support; and we have observed it digging up the roots of the small atamasco lily (*Zepherina atamasco*), and the young and tender shoots of the China brier (*Smilax rotundifolia*) as they shoot out of the ground like asparagus.

---

[48] Making Friends, p. 23.

"It is, moreover, decidedly carnivorous, eating young birds that it may detect on the ground, sucking the eggs in all the partridge, towhee bunting, and other nests it can find in its persevering search. It destroys Mice and other Rodentia, and devours whole broods of young Rabbits, scratching about the nest, and scattering the hair and other materials of which it was composed. We have observed it squatting in the grass and brier thickets in Carolina, which are the common resort of the very abundant Cotton-rat (*Sigmodon hispidum*): and from patches of skin and other mutilated remains, we satisfied ourselves that the Opossum was one among many other species designed by Providence to keep in check the too rapid increase of these troublesome Rats. We must admit that it sometimes makes a sly visit to the poultry house, killing a few of the hens and playing havoc among the eggs. The annoyances of the farmer, however, from this mischievous propensity, are not as great as those sustained from some of the other species: and cannot, for a moment, be compared with the destruction caused by the Weasel, the Mink, or the Skunk."[49]

In Texas, according to Bailey: "They are especially fond of chicken and eggs, and do considerable mischief in the henhouse. They will eat any kind of meat, even when it is old and stale, and often persist in getting into traps baited for more desirable gain. Through the summer, they feed extensively on fruit, and are usually lean and rangy.

. . . .

"On the coast prairies of southeastern Texas, they live much in the open, wandering along the margins of ponds and bayous, sleeping under fallen grass or low bushes and feeding extensively on crawfish and other small crustaceans. In the stomach of one taken near Galveston, I found a horned toad and bird's feathers, besides the meat used for trap bait."[50]

---

[49] Q. N. A., II, pp. 112–13.

[50] Texas, pp. 56–57.

James H. Gaut "found the stomachs of 2 individuals filled with crawfish, one full of carrion of a dead Hog, and in another traces of maggots and carrion."[51]

These various quotations give definiteness to the previous generalities. The observations on his captive Possum made by Charles H. Townsend, well round out our record of the Possum's tastes, and finish with the surprising suggestion that the Possum may chew the cud.

"In captivity," he says, "the Possum is not difficult to cater for. He eats fresh beef, chipped beef, fish, bread and butter, bread and marmalade, soft gingersnaps, cheese, apples, bananas, slices of orange, and raisins, and is probably as omnivorous as the Dog. He wants water only a couple of times a week, but milk is always acceptable. Drinking is done by lapping.

"Banana tastes good to a Possum, and he masticates it with enjoyment, but a fresh minnow is so delectable that he forgets to be retiring; it wakens him from a pretended nap as nearly instantly as a Possum can waken. It disappears faster than banana, and appeases a deep-seated, primitive hunger in a way that explains why his teeth are of the carnivorous pattern.

"The minnows (plump killifishes a couple of inches long) were seized, well chewed and swallowed, when the Possum settled down for a long period of quiet. His tail relaxed its hold on the end of the shelf, and hung down. Next day a live, flopping, 6-inch roach was laid before him, and was seized instantly. The fish was slippery enough to trouble him, and had finally to be taken by the head. A few minutes after eating it, the nose was stretched forward and elevated, with a rapid chewing and sucking motion of the empty jaws; two quick, forward vibratory motions of the body took place, when the mouth was filled with portions of the swallowed fish, which were long and carefully re-chewed. This performance was repeated a second and third time. It looked like a regurgitation and a chewing of the cud. I have not been able to find any reference to this habit among either carnivorous or pouched animals."[52]

CANNIBALISM

Cannibalism is crime, according to our definition, because it is a propensity which, indulged in generally, would soon destroy the species that adopts it. I was not a little surprised to find the mild-mannered Possum convicted of gross cannibalism. Here is the testimony:

"A number of years ago," says Leon L. Pray, "5 live Opossums were sent to the Field Museum of Natural History from southern Illinois. In the

---

[51] Texas, p. 57.

[52] Making Friends, pp. 23–24.

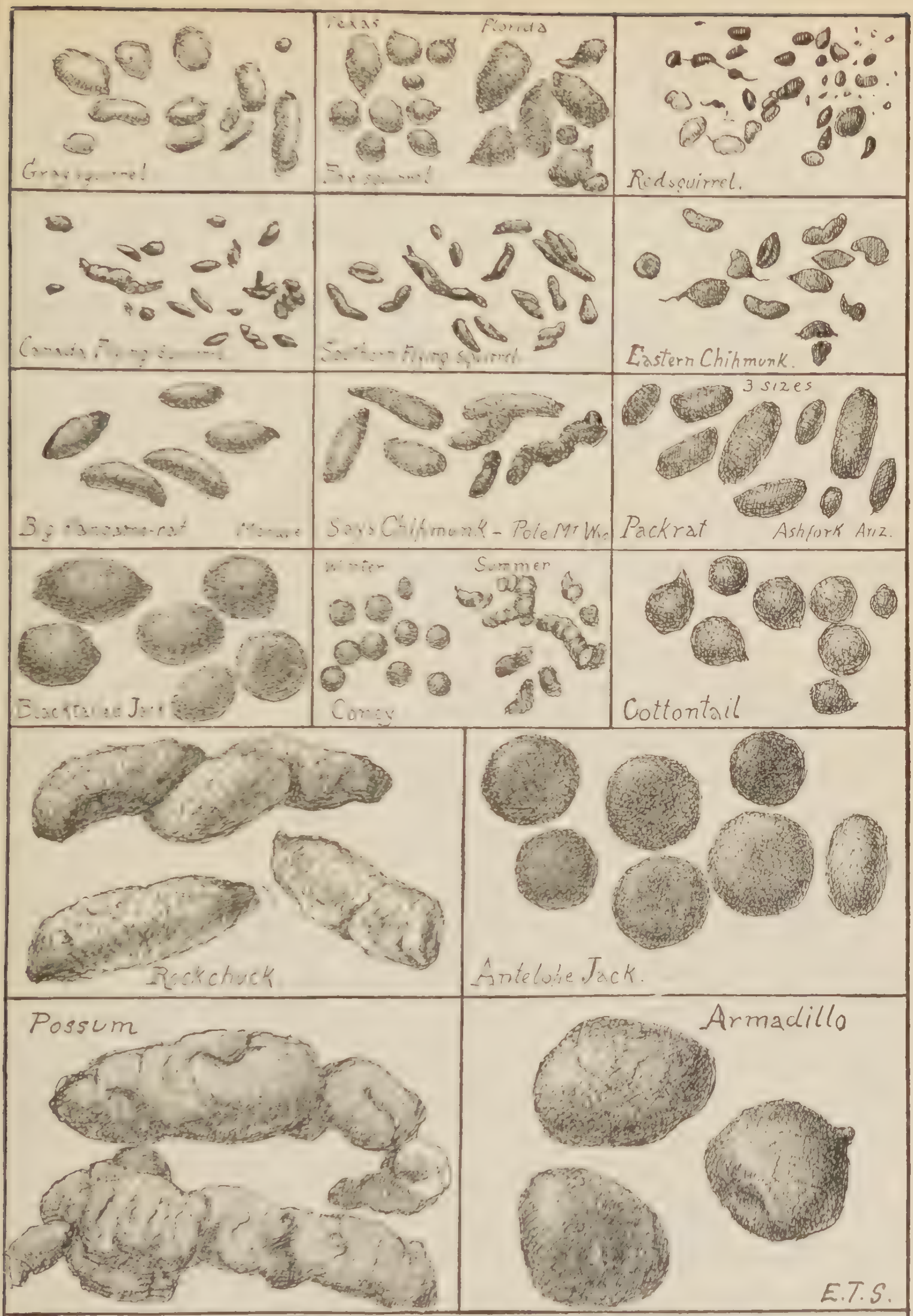


Plate CXIII. Various scats - all are natural size lot were one nearly grown female and 4 young, not her own, about the size of large House-rats. After arrival, they were kept temporarily in a wire-covered barrel. The second night, the large female literally 'ate alive' one of the young, and afterwards forced her escape from the barrel. She had eaten the hindquarters of the unfortunate youngster without first killing him, as attested by his contorted carcass and awful facial grimace when found cold and stiff next day."[53]

It is doubtless unfair to charge a whole species with crime, because one of its members had manifested criminal mania; especially when that individual was a caged, scared, feverish, and desperate animal. The evidence may be complete, but it does not prove that such a crime would have been committed under normal conditions. Nevertheless, another witness appears, and his testimony is even more completely damning than that of the Field Museum man.

H. C. Bechtel, of Evansville, Ind., was out gunning in snowtime, when he found a large Possum track. This he followed; then, in his own words: "It came together with another Possum track, not as large as the first one. They came together in a V-shape. I followed them until they went over the ridge, and down into a small branch bottom. I then crossed a dry branch, and there, on a smooth, level place, I found the smaller Possum had been killed and most of the best meat eaten off him.

"The smaller track stopped there, and the larger one went on. The snow was all trodden down, and smeared with fresh blood, as if they had fought several rounds of about 10 feet in diameter. The head, lower part of the legs, tail, and bones were all intact, only the best of the meat eaten off.

"I then followed the larger track up a ravine, and found where it branched off to one side, and went into a hole in the side of the hill. I got a spade and with the help of a large Dog who scratched the dirt away as fast as I could dig it loose, it was not long before we had Mr. Possum, and as I was the only witness, judge, and jury, we soon executed him on circumstantial evidence, which was very strong, as there was no other track that came into contact with either one of these two tracks from the place I found them to the end of each."[54]

ENEMIES

Almost all animals which are good to eat, are protected from countless enemies by their speed, fighting ferocity, armour, barb-wire fences, or poison gas, as seen in Rabbits, Weasels, Armadillos, Porcupine, and Skunks. Every one of these things has been denied the Possum.

---

[53] Journ. Mamm., May, 1921, p. 109.

[54] Forest & Stream, Aug., 1926, p. 488.

The host of his innumerable enemies are thus sketchily given by Bachman: "In addition to the incessant war waged against it by men and Dogs, we have ascertained that its chief enemy among rapacious birds is the Virginian owl (*Strix virginiana*) which, flying abroad at the same hour in which the Opossum is on foot, pounces on it and kills it with great ease. We have heard of an instance in which it was seen in the talons of the white-headed eagle (*Haliaetus leucocephalus*), and of two or three in which the great henhawk (*F. borealis*) was observed feeding upon it. We recollect no instance of its having been killed by the Wild-cat or the Fox. The Wolf, it is said, seizes on every Opossum it can find: and we have heard of two instances where half-grown animals of this species were found to have been swallowed by the rattlesnake.

"Although the Dog hunts it so eagerly, yet we have never been able to ascertain that it ever feeds upon its flesh; indeed, we have witnessed the Dog passing by the body of a fresh-killed Opossum, and going off for half a mile farther to feed on some offensive carcase."[55]

And yet the Opossum holds its own. Even man has not reduced its territory, as we have seen. These four things are the strong weapons of its equipment for the life-and-death struggle: It lives in a hole underground, it can climb a tree, it comes out only by night, and it is enormously prolific.

Non-hibernant

The Possum is a lover of warmth and of a snug den, is an underground animal of low organization, and one that gets enormously fat in the fall; therefore, by the rules of parallelism, it should hibernate when cold winter comes on—that is, it should go into a cold-sleep or torpor. Yet there is no evidence that it does. Bachman says: "This animal is far from falling into that state of torpidity to which the Marmots, Jumping-mice, and several other species of quadrupeds are subject. In the Southern States, there are not many clear nights of starlight or moonshine, in which they may not be found roaming about; and although in their farthest northern range, they are seldom seen when the ground is covered with snow, yet we recollect having come upon the track of one in snow a foot deep, in the month of March, in Pennsylvania; we pursued it, and captured the Opossum in its retreat—a hollow tree."[56]

---

[55] Q. N. A., II, pp. 116–17.

[56] As above, pp. 111–12.

"It is certain," says Mearns, "that the Opossum sometimes roams abroad during cold winter weather. The night of Jan. 13, 1882, was stormy and cold, and the snow lay deep on the ground; as I returned on horseback from visiting a patient, and had nearly reached my house, the Horse suddenly shied at something in the road that proved to be an Opossum. On another occasion, a specimen was killed in a hennery, Jan. 30, 1877."[57]

Referring to those he got in Genesee and Isabella counties, Mich., Norman A. Wood says: "The above specimens were both caught on very severe nights, the thermometer registering 6° F. on Jan. 18 and—12° on Feb. 5. One would expect that the species would not leave a warm home or nest on such nights. The Raccoon certainly does not venture out in winter except when it is quite warm, and it is much more hardy than the Opossum."[58]

How it keeps its slender, naked, widespread toes and unprotected tail from freezing in zero weather, is a puzzle.

Two Possums that I got in Connecticut, including the one from which the pictures were taken, had their ears badly frozen—totally crumpled by the frost indeed, although they had warm dens, and were never exposed to zero weather. Plate CX.

SANITATION

As a sanitationist, the Possum seems not to have developed very far. This remark is prompted by observations on caged specimens.

Yet Townsend says of his captive: "No animal could be more cleanly. After every meal, the forepaws are licked and the face washed. He often licks the fur and hind paws, the latter being used as combs for the hair of the head and sides."[59]

And Bachman records the habit of taking a tonic sunbath, so widely used by animals, and so little, alas, among ourselves.

"We have observed," says this pioneer naturalist, "in this species, a habit which is not uncommon among a few other species of quadrupeds, as we have seen it in the Raccoon and occasionally in the common House-dog—that of lying on its back for hours in the sun, being apparently dozing, and seeming to enjoy this position as a change."[60]

As already noted, the Possum is as near being strictly nocturnal—black nocturnal—as any animal is ever strictly anything; and yet Bachman says:

"Although nocturnal in its general habits, [it] is not unfrequently, particularly in spring and summer, found moving about by day. We have on several occasions met with it in the woods in midday, in places where it was seldom molested."[61]

---

[57] Fauna Hudson Highlands, Am. Mus. Nat. Hist., Vol. X, Art. XVI, N. Y., Sept. 9, 1898, p. 331.

[58] Notes on Michigan Mammals, 14th Rep. Mich. Acad. Sci., 1912, pp. 163–64.

[59] Making Friends, p. 24.

[60] Q. N. A., II, p. 111.

A similar remark applies to sundry Moles, Gophers, Bats, and other creatures of black darkness, and maybe, in each case, the explanation was the same—they were seeking the blessed, essential purgation of a periodic sunbath.

His Way of Life

Always alone is Possum O'Possum—the fat hermit of the low woods. In the deep, warm den which he made for himself among the long elm roots that defy attempts to dig him out, he has slept all day, quite alone. The sun is gone some time, the shadows of evening have had their little spell; now black night is on the woods. How he knows it, curled up in his black hole, is not easy to say. Perhaps the inner urge of an empty belly it is that sends him forth; and if at the door it seem too soon, he waits. That is all. But sniffing elaborately, twiddling his long whiskers, cocking his thin, skinny ears, he takes in every sound, sense, smell, and vibration that can inform him on the basic questions of foes, friends, or foods in the small world of his possible contacts.

Never far from water is Possum's home; and down to the brookside he waddles in his slow possumic way. First, he takes a drink, then washes his face and hands, combs his hair with his hind feet or front feet, according to which can best reach the spot.

As he strolls along the bank, a scraping, a soft pad-footing catches his ear. He raises his trusty nose and swings to leeward. The sound has ceased; but now, in the black woods, he sees the white face of another Possum. His keen nose assays the wind, and the high vibrations of the incoming message tell him, "Yes, another Possum—and a lady Possum at that." But this is not the mating moon; and she is of no more interest to him than is a bale of hay to a well-fed terrier. So, far from being drawn together, there is positive repulsion between them. She feels her weakness, but shows four threatening rows of teeth—full 50 gleaming points—teeth that an alligator might be proud of—menacing, fierce-looking. But back of their jagged points is no ferocity, and all her threats and warnings are expressed in a feeble hiss. Which matters not at all, for he is indifferent alike to her charm and her menace. He passes on, as a 12-year old "reg'lar feller" passes by a 10-year-old "sissie"—in scornful superiority, to seek his nightly meal.

A few fishworms, misled by the seeming protection of darkness, are promptly pounced on and gobbled with loud biological sounds that betoken relish. A Meadow mouse glides across his path. He makes an ineffectual, too-slow grab for it—and the Mouse is gone. Beetles of several kinds he mangles with noisy champings of his teeth. Then, as he prowls, his vibrant, supersensitive nose guides him to a seedling apple on the ground—ripe and rotten, for this is summer; but he munches it up with slobbery jaws.

---

[61] Q. N. A., II, p. 112.

Then, cocking his white face up and aslant, he achieves a thought—a perfect syllogism indeed—and evidences, at first blush, the powers of a profound thinker, were we not compelled to believe that his woodwise nostrils have more to do with it than his wits. He climbs the tree. Yes, here indeed are plenty of little apples, small and tart, but ripe enough for a Possum feast. He fills his belly, and descends to waddle after other adventures.

A sound in the woods makes him stop and cock his ears—heavy footfalls and snapping of twigs. He takes alarm and seeks safety in a shuffling flight to the nearest small tree. But before he can reach its friendly shaft, a huge beast is on him—a Dog. And Possum falls back on the only trick he knows. He lies like dead, "plays Possum," with neither snarl nor threat, nor any attempt to bite his foe. For the Possum is the original pacifist; non-resistance is his creed, and peace-at-any-price, his method. But the Dog has him and gives him a fierce shake. Why the shake should addle the victim's brains and not the Dog's brains, which are equally shaken at the same time and by the same process, is not clear.

It is unpleasant to the Possum to be shaken, but it does not shake his creed. "Lay low and say nuffin" is his slogan; "hang like limp death" his response. Then the Dog, unstimulated to war by the corpse in his jaws, and not a little repelled by the strange, unfoodlike smell of the woolly Pig, drops the body in a sort of triumphant disgust. Now, a foolish Cat, Rabbit, or Rat with ample powers remaining, would seize on this moment of respite to attempt escape. Not so the Possum. Non-resistance in some cases implies non-escaping. He lies like dead.

The Dog goes on to seek for other glories. The silence of the woods is restored. The Possum slyly peeps around—the coast is clear. He waddles in slow haste to the brook, washes his face, combs his hair, rubs his flanks where enemy jaws bruised him—then, little the worse, he crawls home to bed.

References

1847—Reproduction of *Didelphys virginiana*, by Dr. Charles D. Meigs, Proc. Am. Philos. Soc., Phila., IV, pp. 327–30.

1849—Quadrupeds of North America, by Audubon and Bachman, II, pp. 107-25.

1901—A Preliminary Study of the North American Opossums of the Genus *Didelphis*, by Dr. J. A. Allen, Bull. Am. Mus. Nat. Hist., pp. 149–88.

1905—Biological Survey of Texas, by Vernon Bailey, *N. A. F.*, 25, pp. 56–58.

1912—Making Friends with a Possum, by Charles H. Townsend, *Country Life in America*, Oct. 1, pp. 23–24.

1912—Mammals of Illinois and Wisconsin, by Charles B. Cory, Field Museum, pp. 51–56; map.

1919—Studies in the Development of the Opossum (*Didelphus virginiana*), by Carl G. Hartman, Pts. III and IV, *Journ. Morph.*, pp. 1–140.

1920—Studies in the Development of the Opossum (*Didelphys virginiana*), by Carl G. Hartman, *The Anatomical Record*, Oct., pp. 251–61.

1922—A Brown Mutation in the Opossum (*D. virginiana*), by Carl G. Hartman, *Journ. Mamm.*, Aug., pp. 146–49.

1923—Breeding Habits, Development, and Birth of the Opossum, by Carl Hartman, Smiths. Rep. for 1921, pp. 347–63; 10 pl.

THE END.

SYNOPTIC INDEX

SYNOPTIC INDEX

ABERT, COL. JOHN JAMES, U. S. A. (1788–1863), explorer of the New Mexico region, 68.
aberti, Sciurus, 68, 69.
Abert's Squirrel, *see* Squirrel, Abert's.
Acknowledgments, v
Acorns stored by Gray-squirrel, 31.
Acorus calamus as Muskrat food, 581.
Activity of Little Flying-squirrel, 373.
Adams, Dr. Charles Christopher (1873–), State Museum, Albany, N. Y., sends Collett's paper, 20.
Adams, Ernest C., on Woodchuck burrows, 307.
Adirondacks, Beaver in, 451.
  Chipmunk in, 189.
  Porcupine numbers in, 608.
Ad-jee-dah-mo, *see* Red-squirrel.
Adjidaumo, *see* Red-squirrel.
Age of Beaver, 490.
  Cottontail, 801.
  Fox-squirrel, 106.
  Gray-squirrel, 56.
  Porcupine, 625.
  Red-squirrel, 147.
  Snowshoe Rabbit, 723
  Whitetailed Jack, 663.
agrestis, Thomomys talpoides, 398.
Ah-ging-goos, *see* Chipmunk.
Ah-gwin-gwis, *see* Chipmunk.
Ah-mik, *see* Beaver.
Ah-misk, *see* Beaver.
Ahrens, Theodor George (1870–), Berlin, Germany, on Muskrat in Europe, 571.
Ah-tah-chah, *see* Chipmunk.
alacer, Sylvilagus, 783.
Alaska, Beaver in, 453.
  Red-squirrel food in, 129.
  melano Red-squirrel in, 118.
  Red-squirrel nest in, 137.
  Red-squirrel storage in, 130.
alba, Ondatra, 570.
Alberta, Beaver numbers in, 451.
  Cottontail in, 786.
Albino Beaver, 444.
  Gray-squirrel, 10.
  Muskrats, 570.
  Opossum, 867.
  Porcupine, 605.
  Prairie-dog, 277.
  Red-squirrel, 118.
  Snowshoe Rabbit, 701.
  Woodchuck, 302.
albolimbatus, Sciurus, 152.
Aldrich, Charles, on Woodchuck climbing, 310.
Alexander, Miss Annie Montagu (1868–), of Suisun, Calif., on Mountain Beaver burrows, 535.
Algonquin Park, Beaver numbers in, 447, 450.
Allen, Dr. Glover Morrill (1879–), Mus. Comp. Zool. Cambridge, Mass., on Opossum in Massachusetts, 869.
Allen, Dr. Joel Asaph (1838–1921), of Amer. Mus. Nat. Hist., N. Y., on Fox-squirrel in South Dakota, 84.
  on *Life Histories of Northern Animals*, ix.
  on Rabbit epidemic, 752.
  records melano Red-squirrel, 118.
  on Snowshoe Rabbit change of colour, 702.
alleni, Citellus, 229.
  Lepus, 764, 765.
  Neofiber, 558.
alpinus, Eutamias, 170.
  Glaucomys, 387.
  Thomomys, 397.
altimiræ, Lepus, 766.
Ambystoma, parasite of Gopher, 407.
americanus, Lepus, 700, 701.
Ami, Dr. Henry Marc (1858–), of Ottawa, Ont., acknowledgment to, vii.
amoenus, Eutamias, 170.
Anatomy, Arctic Hare, 669.
  Greenland Hare, 683.
  Marsh Rabbit, 830.
Anderson, Harold M., on Woodchuck fighting Dogs, 335.
Anderson, Dr. Rudolph Martin (1876–), of National Museum, Ottawa, acknowledgment to, vi.
Anderson, Thomas, Hudson's Bay Co. factor of Fort Smith, M. T., on Lynx killed by Beaver, 491.
Animeekong, on meaning of Ad-jee-dah-mo, 117.
Anisocoma acaule (flat dandelion) as Kangaroo-rat food, 426.
Anisonyx rufa, 526.
  rufa named by Rafinesque, 529.
Anteaters Order, characteristics of, 5.
Antelope Jack, contents, 763; life, 764; bed (ill.), 777; dusting places (ill.), 777; map, 607; poses (ill.), 777; salt lick (ill.), 777.
Anthony, Alfred Webster (1865–), of Nat. Hist. Mus., San Diego, on Least Chipmunk hibernation, 180.
  on Muskrat migration, 574.
  on Packrat migration, 506.
  on Packrat storage, 519.
Anthony, Harold Elmer (1890–), of Amer. Mus. Nat. Hist., N. Y., acknowledgment to, v, vi, vi.
  on Coney migration, 640.
  on Mountain Beaver colonies, 532.
  on Mountain Beaver damage, 543.
  on Mountain Beaver drink, 536.
  on Mountain Beaver enemies, 542.

Anthony (*Continued*)
    on Mountain Beaver food, 537.
    on Mountain Beaver food habits, 537.
    on Mountain Beaver life history, 529.
    on Mountain Beaver nocturnalism, 545.
    on Mountain Beaver non-aquatic, 544.
    on Mountain Beaver number, 531.
    on Mountain Beaver pugnacity, 549.
    on Mountain Beaver trapping, 532.
    on Mountain Beaver way of life, 549.
    traps Packrats, 506.
    on Pygmy Rabbit gait and speed, 843.
    on Pygmy Rabbit habits, 842.
    on Pygmy Rabbit haunts, 841.
    on Pygmy Rabbit nocturnalism, 844.
    on Pygmy Rabbit sociability, 843.
    on Pygmy Rabbit young, 844.
anthonyi, Sciurus, 60.
Anticosti, no Porcupines on, 606.
    Red-squirrel on, 121.
Ants, food of Armadillo, 855.
Apache Squirrel, *see* Squirrel, Apache.
Aplodon, *see* Mountain Beaver.
Aplodontia genus, characteristics of, 3, 526.
    genus established by Richardson, 529.
    brune, *see* Mountain Beaver.
    californica, 529.
    columbiana, 528.
    humboldtiana, 528.
    nigra, 528.
    olympica, 528.
    pacifica, 528.
    phaea, 528.
    rainieri, 528.
    rufa, 526, 527.
Aplodontiidae, Family, characteristics of, 3.
Apple stolen by Red-squirrel, 133.
aquaticus, Lepus, 822.
    Sylvilagus, 822, 823.
aquilonia, Ondatra, 570.
Arboreal Chipmunk, 187, 212.
    Franklin Ground-squirrel, 251.
    Striped Ground-squirrel, 234.
    Woodchuck, 309.
    see also Climbing.
Arctic Hare, *see* Hare, Arctic.
arcticus, Lepus, 668, 670.
Arctomys caligatus, 352.
    flaviventer, 338.
    franklinii, 250.
    ludoviciana, 276.
    richardsonii, 260.
Arizona Gray-squirred, *see* Gray-squirrel, Arizona.
arizonæ, Neotoma, 505.
arizonensis, Cynomys, 277.
    Eutamias minimus, 172.
    Sciurus, 112.
Arkansas, Gray-squirrel numbers in, 27.
Arlington Cemetery, Washington, D. C., Fox-squirrel in, 84.
Armadillo, Common, contents, 847; life, 848; feet (ill.), 859; map, 341; penis (ill.), 859; teeth, 848; Armour, 849.
    family, characteristics of, 5.
Armadillo (*Continued*)
    Nine-banded, *see* Armadillo, Common.
    Order, characteristics of, 5.
Armour, Armadillo, 849.
Asapan, *see* Flying-squirrel, Big.
asellus, Lepus, 737.
Assapan, *see* Flying-squirrel, Little.
Assapanick, *see* Flying-squirrel, Little.
atristriatus, Eutamias minimus, 172.
Attacks on man, Muskrat, 594.
Attean Lake, Maine, Red-squirrel swims, 120.
Attwater, Henry Philemon (1854–), of Texas, on Armadillo in Texas, 851.
Audubon, John James (1780–1851), the great bird-artist on Gray-squirrel numbers in Kentucky, 23.
    see also Bachman.
Audubon, John Woodhouse (1812–1862), son of the above, also an artist-naturalist (about half the drawings in Q. N. A. are his, chiefly Western species)
    on Armadillo burrows, 854.
    on Armadillo curling self up, 858.
    on Armadillo food, 855.
    on Armadillo rolling downhill, 858.
    on Armadillo tamability, 860.
    on Armadillo voice, 860.
    on Armadillo when attacked, 860.
Au-kuk-wah-djees, *see* Woodchuck.
Austin, George P., on Opossum in California, 870.
avara, Marmota, 339.
avicennia, Sciurus, 84.
aztecus, Sylvilagus, 783.

B., J. R. M., on Negro method of catching Cottontail, 796.
Babcock, Dr. Stephen Moulton (1843–), on Blacktailed Jack drink, 748.
Bachelor Beaver, 476.
Bachman, Rev. John (1790–1874) (wrote the text of Q. N. A.)
    on Armadillo flesh, 862.
    on Armadillo numbers in Nicaragua, 852.
    on Beaver numbers, 449.
    on Beaver weight, 444.
    on California Gray-squirrel food, 61.
    on California Gray-squirrel way of life, 65.
    on Chipmunk as birdicide, 201.
    on Chipmunk cheek pouches, 202, 204.
    on Chipmunk hibernation, 214.
    on Chipmunk storage, 205.
    on Chipmunk and Weasel fight, 196.
    on Cottontail borning, 808.
    on Cottontail broods, 808.
    on Cottontail numbers in N. Y., 801.
    on Cottontail tamability, 807.
    on Douglas Squirrel family life, 155.
    on Douglas Squirrel food, 155.
    on Fox-squirrel courage, 100.
    on Fox-Squirrel den, 93.
    on duck as rival to Fox-squirrel, 104.
    on Fox-squirrel ground habits, 98.
    on Fox-squirrel laziness, 100.
    on Fox-squirrel mating, 94.
    on Fox-squirrel nest and young, 94.

Bachman (*Continued*)
  on Fox-squirrel numbers, 86.
  on owl no enemy to Fox-squirrel, 103.
  on Fox-squirrel running ¼ mile, 98.
  on Big Flying-squirrel mother devotion, 392.
  on Big Flying-squirrel nursing young, 393.
  on Big Flying-squirrel speed, 389.
  on Little Flying-squirrel broods, 378.
  on Little Flying-squirrel flight, 375.
  on Little Flying-squirrel food, 373.
  on Little Flying-squirrel mother carrying young, 379.
  on Little Flying-squirrel nesting, 377.
  on Little Flying-squirrel numbers, 371.
  on Little Flying-squirrel sociability, 372, 383.
  on Gray-squirrel fighting, 42.
  on Gray-squirrel food, 28.
  on Gray-squirrel food habits, 30.
  on hawk *vs.* Gray-squirrel, 51.
  on Gray-squirrel migration, 14.
  on Gray-squirrel nests, 43.
  on Gray-squirrel nocturnal, 49.
  on Gray-squirrel number in Ohio, 23.
  on Gray-squirrel tamability, 50.
  on Gray-squirrel young, 46.
  on Marsh Rabbit anatomy, 830.
  on Marsh Rabbit bathing, 836.
  on Marsh Rabbit broods and young, 834.
  on Marsh Rabbit flesh, 834.
  on Marsh Rabbit food, 833.
  on Marsh Rabbit habits, 835.
  on Marsh Rabbit haunts, 832.
  on Marsh Rabbit history, 831.
  on Marsh Rabbit nest, 834.
  on Marsh Rabbit numbers, 832, 833.
  on Marsh Rabbit parasites, 833.
  on Marsh Rabbit track, 834.
  on Marsh Rabbit weight, 830.
  on Muskrat young, 600.
  on Opossum broods, 876.
  on Opossum den, 873.
  on Opossum diurnalism, 894.
  on Opossum enemies, 893.
  on Opossum feigning death, 885.
  on Opossum food, 888.
  on Opossum gait, 882.
  on Opossum hibernation, 893.
  on Opossum home range, 872.
  on Opossum nest, 874.
  on Opossum nocturnalism, 885.
  on Opossum numbers in South Carolina, 871.
  on Opossum sunbath, 894.
  on Opossum tamability, 887.
  on Opossum young, 875, 880.
  on animals killed by Porcupine quills, 662.
  on Porcupine damage to trees, 627.
  on Porcupine *vs.* Dog, 662.
  on Porcupine home range, 606.
  on Rabbit tracks, 824.
  on Snowshoe Rabbit mating, 718.
  on Snowshoe Rabbit nest, 718.
  on Snowshoe Rabbit young, 720.
  on Swamp-rabbit broods, 825.
  on Swamp-rabbit feet, 823.
  on Swamp-rabbit food, 824.
Bachman (*Continued*)
  on Swamp-rabbit haunts, 823.
  on Swamp-rabbit nest, 825.
  on Swamp-rabbit numbers, 824.
  on Swamp-rabbit stamping, 824.
  on Swamp-rabbit way of life, 826.
  on Swamp-rabbit weight, 822.
  on Woodchuck climbing, 310.
  on Woodchuck family life, 318.
  on Woodchuck hibernation, 320.
  on Woodchuck mother love, 318.
  on Woodchuck tamability, 327.
  on Woodchuck weight, 301.
bachmani, Lepus, 818.
Badger, enemy to Blacktailed Jack, 751.
  enemy to Flickertail, 270.
  enemy to Franklin Ground-squirrel, 257.
  enemy to Gopher, 405.
  enemy to Kangaroo-rat, 434.
  enemy to Mountain Beaver, 542.
  enemy to Packrat, 510.
  enemy to Prairie-dog, 296.
  enemy to Striped Ground-squirrel, 242.
Badger, Mountain, *see* Marmot, Hoary.
  Thickwood, *see* Woodchuck.
  Whistling, *see* Marmot, Hoary.
badius, Citellus, 229.
Bagg, Dr. Clinton Levi (1856–1924), on Little Flying-squirrel young, 378.
  on Woodchuck numbers, 304.
Bailey, Alfred Marshall of Chicago Acad. Sci., and Hendee, Russell W., on Arctic Hare numbers, 673.
Bailey, Bernard, of Elk River, Minn., on Gray-squirrel as birdicide, 34.
  on Little Flying-squirrel as birdicide, 374.
  on Striped Ground-squirrel attacking chicken, 239.
  on Woodchuck climbing, 310.
Bailey, Florence Merriam (Mrs. Vernon Bailey), (1863–)
  on Coney life, 642.
  on Coney manners, 641.
Bailey, Vernon, (1864–), of Biol. Surv., U. S., acknowledgment to, v, vi.
  on Armadillo excrement, 856.
  on Armadillo haunts, 853.
  on Armadillo numbers, 852.
  on Armadillo range, 850.
  on Armadillo way of life, 861.
  on Armadillo young, 854.
  on caring for baby Beaver, 474.
  on Beaver mating, 473.
  on Beaver parasites, 495.
  on Beaver split toe nail, 494.
  on Beaver weight, 444.
  on Beaver young, 474.
  on Blacktailed Jack eating watermelons, 748.
  on Chipmunk at Turtle Mountain, 187.
  on weatherwise Coney, 643.
  on Coney winter life, 644.
  on Cottontail in South Dakota, 786.
  on Coyote *vs.* Blacktailed Jack, 751.
  on Flickertail damage, 269.
  on Flickertail food, 269.

Bailey (*Continued*)
  on Flickertail numbers, 263.
  on Flickertail weight, 260.
  on Franklin Ground-squirrel eating Mice, 255.
  on Gray-squirrel drinking, 34.
  on Gray-squirrel food, 30.
  on Gray-squirrel hibernation, 36.
  on Gray-squirrel mating, 42.
  on Gray-squirrel storage, 31.
  on Gray-squirrel weight, 10.
  on Gray-squirrel young, 46.
  on Hoary Marmot breeding, 359.
  on Hoary Marmot food, 355.
  on Hoary Marmot hibernation, 363.
  on Hoary Marmot travelling to food, 360.
  on Hoary Marmot young, 358.
  on Kangaroo-rat doorways, 430.
  on Kangaroo-rat drumming, 431.
  on Kangaroo-rat food, 425.
  on Kangaroo-rat prospect holes, 427.
  on Kangaroo-rat storage, 425.
  on Opossum brain capacity, 882.
  on Opossum food, 889.
  on Opossum numbers in Texas, 871.
  on Opossum number of young, 880.
  on Opossum when trapped, 884.
  on Opossum weight, 886.
  on horned owl *vs.* Packrat, 510.
  on Packrat musk, 512.
  on Packrat nests and trails, 515.
  on Prairie-dog damage, 283.
  on Prairie-dog numbers in New Mexico, 281.
  on Prairie-dog numbers in Texas, 280.
  on Rockchuck food, 342.
  on Striped Ground-squirrel burrows, 232.
  on Striped Ground-squirrel food, 237, 238, 240.
  on Striped Ground-squirrel hibernation, 244.
  on Striped Ground-squirrel numbers, 231.
  on Striped Ground-squirrel storage, 240.
  on Striped Ground-squirrel voice, 234.
  on Woodchuck climbing, 310.
  on melano Woodchuck, 302.
baileyi, Sciurus, 119.
bairdii, Lepus, 701.
Bakewell, Mrs. M. D., on Opossum bringing home friends, 884.
Baldwin, Capt. Charles H., on Armadillo eating ants, 855.
Bales, L. L., on Arctic Hare numbers, 671.
Balfour, John Hutton (1808–1884), Prof. of botany and medicine, Univ. Edinburgh, on tree decay, 417.
Ballard, Angus, on Woodchuck feeding habits, 332.
  on Woodchuck hunting, 330.
  on Woodchuck voice, 314.
Banana as Roundtailed Muskrat food, 564.
Bancroft, Merle Fowler (1890–), Can. Geol. Surv., on Packrat drumming, 512.
  on Packrat nest and young, 517.
Bangs, Outram (1863–), Mus. Comp. Zool., Cambridge, Mass.,
  on Fox-squirrel ground habits, 98.
  on Gray-squirrel in Everglades, 13.
  on Marsh Rabbit habits, 835.
Bangs (*Continued*)
  on Marsh-rabbit numbers in Florida and Georgia, 832.
  on Round-tailed Muskrat haunts, 559.
  on Round-tailed Muskrat nest, 562.
  on Round-tailed Muskrat numbers, 561.
  on Round-tailed Muskrat trapping, 565.
bangsi, Glaucomys, 387.
bangsii, Lepus, 670.
Bank Beavers, 469.
Bank-den, Beaver, 469.
  Muskrat, 586.
Bank-lodge, Beavers (ill.), 479, 486.
Bannertail, *see* Gray-squirrel.
Bannon, Henry, of Portsmouth, Ohio, on Beaver curiosity, 480.
  on Beaver footing selves, 488.
  on Beaver numbers, 449.
  on Beaver storage, 485.
Banquet Hall, Kangaroo-rat, 428.
barberi, Sciurus, 69.
Bark as Packrat food, 518.
Barker, Franklin Davis (1877–), zoologist, Nebr. Acad., Lincoln, Nebr., on Muskrat parasites, 592.
Barker, Col. James, on Gray-squirrel migration, 16.
Barker, Prairie, *see* Prairie-dog.
Barker's Farm-house, Toronto, Black-squirrel at, 56.
Barking of trees, Cottontail, 790.
Bark-stones, Beaver, 481.
Barnes, Will Croft (1858–), of U. S. Forestry Service, on Beaver numbers, 454.
Barre, de la, *see* De la Barre.
Barton, Arthur S., editor *Recorder*, Boissevain, Man., on Flickertail spring arrival, 264.
  on Least Chipmunk numbers, 175.
  on Whitetailed Jack disease, 662.
  on Whitetailed Jack mating, 656.
  on Whitetailed Jack range, 651.
  size of his Whitetailed Jack, 648.
  finds piles of Rabbit skeletons, 728.
  on whitetailed Jack tamability, 657.
Bartram, William (1739–1823), American botanist and ornithologist, Phila., Pa.,
  on Chipmunk as birdicide, 200.
Baskahegan Lake, Me., pickerel catches Red-squirrel at, 125.
Baskett, James M., on use of Fox-squirrel tail, 102.
Bass, William, on Beaver young, 474.
Bathing, Marsh-rabbit, 236.
battyi, Lepus, 765.
Bay City *Tribune*, on Gray-squirrel numbers in Michigan, 17.
Bay, Dr. Edvard (1867–), companion of Sverdrup, on Greenland Hare behaviour, 692.
  on Greenland Hare numbers on Ellesmere Id., 687.
Beal, Prof. Foster Ellenborough Lascelles (1840–1916), ornithologist, Ames, Ia.
  on Striped Ground-squirrel eating caterpillars, 237.
  on Striped Ground-squirrel eating Mouse, 238.

Bear, enemy to Arctic Hare, 673.
 enemy to Beaver, 493.
 enemy to Greenland Hare, 695.
Beaver, American, *see* Beaver.
 Canadian, *see* Beaver.
Beaver, contents, 441; life, 443; bank lodge (ill.), 479, 486; burrow (ill.), 479; canals (ill.), 468; chips (ill.), 492; diving (ill.), 492; family (ill.), 454; feet (ill.), 456; map, 446; old print (ill.), 494; poses (ill.), 486; scratching (ill.), 486; skull (ill.), 293; teeth, 443; use of tail (ill.), 486; in Winnipeg Zoo (ill.), 470.
 Family, characteristics of, 3.
 Ground, *see* Mountain Beaver.
 Mountain, *see* Mountain Beaver.
 Musk, *see* Muskrat.
 Muskrat, *see* Mountain Beaver.
 Underground, *see* Mountain Beaver.
Beaver-meadows, 462.
Bechtel, H. C., on Opossum cannibalism, 892.
Beck, J. M., finds Little Flying-squirrel family, 372.
Beck, R. R., excavates Prairie-dog burrows, 289.
Bed, Antelope Jack (ill.), 777.
 Arctic Hare, 675.
 Beaver, 471.
Bees attack Fox-squirrel, 104.
Belaire, Dr. G. H., on Gray-squirrel in Ontario, 11.
Belden, George P., (–1871) on Beaver numbers, 449.
 on Porcupine tail used to make combs, 628.
Bell, Cottontail, 786; (ill.), 805.
Bell, Dr. Charles Napier (1854–), of Winnipeg, on Red-squirrel storage, 130.
Bell, Dr. Gordon, of Winnipeg, on Muskrat young, 600.
 on Snowshoe Rabbit plague, 707.
Bell, James F. Expedition, reports nocturnal Red-squirrel, 142.
Bell, John Graham, of N. Y. (1812–1889), on Porcupine numbers, 608.
Bell, Dr. Robert (1841–1917), of Can. Geol. Surv., on earthworms, 413.
 on Least Chipmunk at Nelson and Churchill rivers, 172.
 on Porcupine numbers in Labrador, 608.
Bell, William Bonar (1877–), of U. S. Biol. Surv., on poison *vs.* Rabbits, 758.
Bellalise, Athabaska Indian guide, on fighting Muskrats, 594.
 on winter-killed Muskrats, 593.
 on Porcupine young, 615.
belugæ, Castor, 445.
Bemis, William Edward, 1864–1915, on Snowshoe Rabbit drumming, 733.
Bendire, Major Charles Emil, U. S. A. (1836–1897), on Rabbit epidemics, 753.
bennettii, Lepus, 737.
Bernard, John, Beaver caller, 480.
bernardinus, Callospermophilus, 220.
Berry, Samuel Stillman, on Beaver canal, 467.
Bicknell, Eugene Pintard, (1859–1925)
 on Porcupine sounds, 611.
 on Porcupine stupidity, 610.
Big Flying-squirrel, *see* Flying-squirrel, Big.
Biological Survey, U. S.; acknowledgment to, v, x.
 on Cottontail numbers in U. S., 803.
 on destroying Prairie-dogs, 283.
 on poison *vs.* Rabbits, 758.
 on Prairie-dog numbers, 280.
 on spotted fever, 273.
Birdicide, Abert's Squirrel as a, 78.
 Armadillo as a, 856.
 Chipmunk as a, 200.
 Cottontail is no, 790.
 Douglas Squirrel as a, 156
 Fox-squirrel as a, 92.
 Franklin Ground-squirrel as a, 255.
 Gray-squirrel as a, 34.
 Little Flying-squirrel as a, 374.
 Muskrat as a, 582.
 Opossum as a, 889.
 Red-squirrel as a, 134.
 Striped Ground-squirrel as a, 238.
Birds scattered by Beaver, 496.
Birdseye, Clarence, on Rockchuck food, 342.
 on Rockchuck numbers in Montana, 342.
 on Rockchuck parasites, 345.
bishopi, Lepus, 701.
Blackbear, enemy to Beaver, 493.
 killed by Porcupine quills, 623.
Blackburne, William Henry (1856–), of Nat. Zoo, on Beaver weight, 444.
Black-squirrel, *see* Squirrel, Abert's.
 see also Gray-squirrel.
 White-nosed, *see* Fox-squirrel.
Blacktailed Jack, *see* Jack, Blacktailed.
Blair, Dr. William Reid (1875–), direction N. Y. Zool. Park, on Snowshoe Rabbit disease, 712, 713.
Blandford, Charles G., on Cottontail dying of fright, 796.
Bobcat, enemy to Black-tailed Jack, 751.
 enemy to Gray-squirrel, 52.
 enemy to Mountain Beaver, 542.
 enemy to Packrat, 510.
 killed by Porcupine quills, 622.
Bogan, J. F., on snake *vs.* Gray-squirrel, 53.
Boomer, Mountain, *see* Mountain Beaver.
Boone, Daniel (1735–1820), Alleghany pioneer, kills Gray-squirrels, 23.
Boquet, J. M., on Armadillo in Texas, 851.
borealis, Eutamias minimus, 172.
Borning, Blacktailed Jack, 742.
 Porcupine, 614.
 Whitetailed Jack, 656.
Bothiocephalus, enemy to Porcupine, 624.
bottae, Thomomys, 397.
Bounty on Flickertail, 263, 269.
Bowdish, Beecher Scoville, of Demarest, N. J., on Woodchuck climbing, 310.
Brachylagus genus, characteristics of, 5, 840.
 idahoensis, 840.
Brain capacity, Arctic Hare, 882.
 Coyote, 882.
 Hog-nosed Skunk, 882.
 Kitfox, 882.
 Opossum, 882.

Brain capacity (*Continued*)
  Porcupine, 882.
  Redfox, 882.
  Skunk, 882.
  Wolf, 882.
Braithwaite, Henry Gamaliel, N. B. pioneer and guide,
  on Bear *vs.* Beaver, 493.
  on Beaver age, 490.
  on Beaver beds, 471.
  on Beaver dam of stones, 463.
  on daylight Beavers, 489.
  on Beaver family life, 476.
  on Beaver lodge strength, 471.
  on Lynx *vs.* Beaver, 491.
  on Beaver under-water stay, 473.
  on Beaver *vs.* Dog, 472.
Brander-Dunbar, Capt., on European Hare voice, 747.
Bravery, Cottontail, 812.
  Woodchuck, 333.
Brayton, Dr. Alembert Winthrop (1848–), on Gray-squirrel migration, 16.
Breck, Edward (1861–), editor, naturalist, on Big Flying-squirrel cannibalism, 391.
Breeding, Big Flying-squirrel, 392.
  Hoary Marmot, 358.
  Little Flying-squirrel, 378.
  Mountain Beaver, 541.
  Muskrat, 598.
  Opossum, 874.
  Rockchuck, 343.
  Roundtailed Muskrat, 563.
Brendel, quoted by Kennicott, on Little Flying-squirrel nest, 377.
Brennan, Jim, takes horned Cottontail, 787.
Bretherton, Bernard J., on Mountain Beaver haymaking, 538.
  on Mountain Beaver hibernation, 548.
  on Mountain Beaver nocturnalism, 537.
Brett, Col. Lloyd Milton (1856–1927), U. S. A., Supt. Yellowstone Park,
  on Beaver cutting trees, 460.
Brewster, William (1851–1919), naturalist, Cambridge, Mass., acknowledgment to, vi.
  on Chipmunk as birdicide, 201.
  on Chipmunk migration, 189.
  on defense of Red-squirrel, 136.
  on Red-squirrel mating, 139.
  on Snowshoe Rabbit swimming, 715.
Brickell, Dr. John, pioneer of N. C. 1737, on Opossum names, 866.
Brimley, Clement Samuel, (1863–) N. C. Acad.
  on Cottontail young, 808.
  on Little Flying-squirrel broods, 378.
  on Muskrat broods, 599.
  on Opossum colour mutation, 867.
Brimley, Herbert Hutchinson, State Mus., Raleigh, N. C., on Cottontail numbers in North Carolina, 802.
Brinton, Dr. Daniel Garrison (1837–1899), surgeon and ethnologist, Phila. Acad. Nat. Sci., and Anthony, Rev. Albert Seqaqkind, their Lenape Dictionary, 301.
  on Opossum names, 866.
Bristles, Red-squirrel (ill.), 131.
British Columbia, Beaver numbers in, 451.
Broatch, James P., on Gray-squirrel migration, 18.
Brodie, William George Alexander (1862–1883), captures Red-squirrel at Carberry, 122.
Brons, Dr. H. H., on Prairie-dog, owl, and rattler living together, 294.
Bronx Park, N. Y., number of Red-squirrels at, 119.
Broods, Arctic Hare, 677.
  Big Flying-squirrel, 392.
  Blacktailed Jack, 741.
  Cottontail, 808.
  Franklin Ground-squirrel, 254.
  Gray-squirrel, 43, 46.
  Greenland Hare, 692.
  Kangaroo-rat, 436.
  Least Chipmunk, 175.
  Little Flying-squirrel, 378.
  Marsh-rabbit, 834.
  Muskrat, 598.
  Opossum, 875.
  Packrat, 517.
  Porcupine, 615.
  Prairie-dog, 289.
  Rockchuck, 343.
  Say's Chipmunk, 224.
  Snowshoe Rabbit, 720.
  Striped Ground-squirrel, 234.
  Swamp-rabbit, 825.
  Whitetailed Jack, 657.
Brooks, Major Allan (1869–), of Okanagan Landing, B. C.
  on Cottontail in Ontario, 784.
  on Douglas Squirrel voice, 154.
  on Mountain Beaver drink, 536.
  on Mountain Beaver food, 536.
  on Mountain Beaver haunts, 530.
  on Mountain Beaver life history, 529.
  on Mountain Beaver way of life, 548.
  on Porcupine damage to Dogs, 626.
  on Porcupine eating soap, 627.
  on Porcupine as food, 628.
  on eagle as Rockchuck enemy, 344.
  on Rockchuck hibernation, 348.
  on melano Rockchuck, 339.
  on Rockchuck young, 343.
Brooks, Alonzo Beecher (1873–), U. S. Dept. Agri., on Beaver in West Virginia, 452.
Brooks, Fred Ernest, of French Creek, W. Va., on Gray-squirrel eating bark, 29.
Brooks, F. and A., on Cottontail voice, 789.
brooksi, Ochotona, 638.
Brown, Eliot C., on Red-squirrel eating mould, 133.
Brown, William S., on Porcupine flesh, 628.
Bruce, David, on Red-squirrel eating chicks, 134.
Bruner, Prof. Lawrence (1856–), of Univ. Nebr., Lincoln, Nebr.
  on Franklin Ground-squirrel food, 255.
  on Striped Ground-squirrel eating Mouse, 238.
Brunner, Josef, on Beaver use of tail, 458.
brunnescens, Ochotona, 638.
Bryan, Game Warden, on game numbers in Louisiana, 802.

- Bryant, Dr. Harold Child (1886–), of Calif. Mus. Vert. Zool., Berkeley,
  - on Beaver in California, 452.
  - on California Gray-squirrel plague, 66.
- bryanti, Sciurus, 84.
- Buchahudry or Chief, *see* Coney.
- Bucka-thrae Kah-yawzae, *see* Coney.
- Buffalo eaten by Flickertail, 269.
- Buffalo, N. Y., Gray-squirrels land at, 15.
- Buffon, Georges Louis Leclerc, Comte de (1707–1788),
  - on Fox-squirrel names, 82. (*See* Vol. II, p. 262, for an appraisal of his great work.)
- bulbivorus, Thomomys, 397.
- bullatus, Glaucomys, 387.
  - Thomomys talpoides, 398.
- Buller, Prof. Arthur Henry Reginald (1874–), of Univ. of Manitoba, Wpg., on Red-squirrel eating mushrooms, 132.
  - on Red-squirrel storage, 130.
- Bummer, *see* Say's Chipmunk.
- Bunny, Brush, *see* Rabbit, Brush.
- Burnett, William Lewis, on Prairie-dog breeding and young, 289.
  - on Prairie-dog burying their dead, 296.
  - on Prairie-dog damage, 282.
- Burroughs, John (1837–1921), literary naturalist,
  - on Chipmunk burrows, 191.
  - on Chipmunk migration, 189.
  - on Chipmunk sociability, 190.
  - on Opossum in New York, 869.
  - his coat of Woodchuck, 313.
  - on Woodchuck home range, 304.
  - on melano Woodchuck, 302.
  - on Woodchuck numbers, 304.
- Burroughs Medal to E. T. Seton, x.
- Burrow, Antelope Jack, 769.
  - Armadillo, 853.
  - Beaver, 469; (ill.), 479.
  - Chipmunk, 191.
  - Cottontail, 804.
  - Flickertail, 266; (ill.), 267.
- Gopher, 404, 407; (ill.), 406, 409, 415.
  - Hoary Marmot, 356.
  - Kangaroo-rat, 428; (ill.), 435.
  - Mountain Beaver, 531, 533; (ill.), 546.
  - Prairie-dog, 284; (ill.), 285, 290.
  - Pygmy Rabbit, 842, 843.
  - Roundtailed Muskrat, 561.
  - Say's Chipmunk, 223,
  - Striped Ground-squirrel, 232; (ill.), 245.
  - Woodchuck, 305; (ill.), 329.
- Burrowing, Gopher, 402.
- Burrow system, Mountain Beaver (ill.), 546.
- Burying his dead, Prairie-dog, 296.
- Bush-rat, *see* Packrat.
- Buttree, Mrs. Julia M., acknowledgment to, vii.
  - on Gray-squirrel singing to sparrows, 41.
- Byington, Rev. Cyrus (1793–1868), missionary, author Choctaw dictionary.
  - on Chipmunk names, 184.
  - on Gray-squirrel names, 9.
  - on Opossum names, 866.
- Byron, A. M., on Blacktailed Jack mating, 740.
- C., D. W., on Little Flying-squirrel carrying young, 379.
- Caches, *see* Storage.
- cacodemus, Eutamias minimus, 171.
- Cadham, Dr. Fred J., of Winnipeg, on Muskrat fight, 594.
- Cadham, J. H., Winnipeg pioneer, father of the above.
  - on Snowshoe Rabbit plague, 707.
  - on Snowshoe Rabbit years, 706.
  - on Whitetailed Jack range, 651.
  - on Whitetailed Jack in Manitoba, 651.
  - on Whitetailed Jack *vs.* Dog, 660.
- caecator, Castor, 445.
- Cahn, Alvin Robert (1892–), zoologist.
  - on Porcupine food, 617.
  - on Porcupine numbers in Minnesota, 608.
- Caldwell, Mrs. Mildred Bedard, on Snowshoe Rabbit young, 721.
- Calico-chip, *see* Chipmunk, Say's.
- California, Beaver in, 452.
  - Opossum in, 870.
- California Gray-squirrel, *see* Gray-squirrel, California.
- California University, acknowledgment to, v.
- californica, Aplodontia, 528.
  - Lepus, 736.
- californicus, Glaucomys, 388.
  - Lepus, 736, 737.
- caligata, Marmota, 352, 353.
- caligatus, Arctomys, 352.
- Callo, *see* Chipmunk, Say's.
- Callospermophilus genus, characteristics of, 1, 218.
  - bernardinus, 220.
  - caryi, 219.
  - castanurus, 220.
  - certus, 219.
  - chrysodeirus, 219.
  - cinerascens, 219.
  - lateralis, 218, 219.
  - madrensis, 220.
  - perpallidus, 219.
  - saturatus, 219.
  - tescorum, 219.
  - trepidus, 220.
  - trinitatis, 219.
  - wortmani, 220.
- callotis, Group, 765.
- callotis, Lepus, 765.
- Camp, Charles Lewis (1893–), zoologist, Amer. Mus. Nat. Hist.
  - on Mountain Beaver climbing, 545.
  - on Mountain Beaver colonies, 534.
  - on Mountain Beaver enemies, 542.
  - on Mountain Beaver feeding habits, 537, 538.
  - on Mountain Beaver food, 536, 537.
  - on Mountain Beaver gifts, 544.
  - on Mountain Beaver haunts, 530.
  - on Mountain Beaver haymaking, 539.
  - on Mountain Beaver hibernation, 547.
  - on Mountain Beaver life history, 529.
  - on Mountain Beaver nest, 541.
  - on Mountain Beaver nocturnalism, 537.
  - on Mountain Beaver sanitation, 540.
  - on Mountain Beaver storeroom door, 540.

Camp (*Continued*)
    on Mountain Beaver trapping, 542, 543.
    on Mountain Beaver voice, 541.
    on Mountain Beaver water control, 535.
campanius, Lepus, 650.
campioni, Marmota, 339.
Camps wrecked by Porcupines, 627.
Camsell, Arthur Frederick, of Fort Simpson, Mackenzie River, sees Least Chipmunk in snow, 181.
Canada, Muskrat fur trade in, 576.
canadensis, Castor, 443, 444.
    Marmota, 303.
Canals, Beaver, 466.
    Beaver (ill.), 468.
    Muskrat, 586.
Candles carried off by Flying-squirrel, 391.
Cane-cutter, *see* Rabbit, Swamp.
canescens, Glaucomys, 387.
caniceps, Eutamias minimus, 172.
Cannibalism, Big Flying-squirrel, 391.
    Chipmunk, 201.
    Cottontail, 792.
    Opossum, 890.
    Snowshoe Rabbit, 717.
    Striped Ground-squirrel, 240.
canus, Lepus, 670.
Capistrate, *see* Fox-squirrel.
Caracara *vs.* Antelope Jack, 769.
    enemy of Blacktailed Jack, 751.
Carberry, Man., Red-squirrel at, 122.
carolinensis, Castor, 444.
    Sciurus, 9, 10.
Carousel, Red-squirrel, 144.
Carrying Fox-squirrel young, 95.
    Packrat young, 517.
    Red-squirrel young, 141.
Carter, Thomas D., on Muskrat storage, 585.
    on Muskrat tunnels, 587.
Cary, Merritt (1880–1918), U. S. Biol. Surv.,
    on Abert Squirrel food habits, 78.
    on Abert Squirrel melanism, 68.
    on Abert Squirrel migration, 70.
    on Abert Squirrel nest, 72, 73.
    on Abert Squirrel numbers, 70.
    on Abert Squirrel voice, 72.
    on Abert Squirrel way of life, 76.
    on Fremont Squirrel nest, 165.
    on Fremont Squirrel voice, 165.
    on Opossum in Colorado, 870.
    on Packrat stealing traps, 521.
caryi, Callospermophilus, 219.
    Eutamias minimus, 171.
    Thomomys talpoides, 398.
cascadensis, Lepus, 701.
    Marmota, 353.
    Sciurus, 152.
Case, William, on Porcupine numbers in Ohio, 608.
Casey, Dr. Michael Lester (1870–), on Snowshoe Rabbit plague, 712.
castanurus, Callospermophilus, 220.
Castles, Rockchuck (ill.), 348.
Castor, *see* Beaver.
    genus, 3, 443.
    belugæ, 445.
Castor (*Continued*)
    caecator, 445.
    canadensis, 443, 444.
    carolinensis, 444.
    described, 481.
    frondator, 444.
    leucodonta, 445.
    mexicanus, 445.
    michiganensis, 445.
    missouriensis, 445
    phaeus, 445.
    shastensis, 445.
    texensis, 445.
    subauratus, 445.
    zibethicus, 569.
Castoridæ Family, characteristics of, 3, 443.
Cat attacked by owl, 724.
    enemy to Big Flying-squirrel, 390.
    enemy to Chipmunk, 197.
    adopts Gray-squirrel, 47; (ill.), 46.
    no enemy to Gray-squirrel, 52.
    adopts Red-squirrel young, 140.
    sanitation of, 138.
Cat, Mud, *see* Muskrat.
Catesby, Mark (1679[?]–1749), famous naturalist in Carolina, etc., calls Woodchuck *Monax*, 300.
Catskills, Porcupine numbers in, 608.
Cave-rat, *see* Packrat.
Cawquaw, *see* Porcupine.
Central Park, N. Y., Gray-squirrel numbers in, 24.
Century Magazine publishes *Dipo*, 421.
    publishes Gopher Life, 396.
cerrosensis, Sylvilagus, 819.
certus, Callospermophilus, 219.
Chamber, Beaver, 471.
    Kangaroo-rat, 428.
Chamberlain, Montagu (1844–1924[ ]), N. B. Nat. Hist. Soc., on Gray-squirrel in New Brunswick, 11.
Change of coat, Arctic Hare, 669.
Change of Colour, Snowshoe Rabbit, 702.
Chan-pah, *see* Beaver.
Chapman, Dr. Frank Michler (1864–), Amer. Mus. Nat. Hist.
    on Roundtailed Muskrat food, 563.
    on Roundtailed Muskrat habits, 559, 564.
    on Roundtailed Muskrat numbers, 561.
chapmani, Sylvilagus, 783.
Charleson, John S., taxidermist, Manitoba, on owl eating Big Flying-squirrel, 390.
    on Opossum in Saskatchewan, 870.
    on Striped Ground-squirrel spring arrival, 232.
Chatham, John H., on Gray-squirrel migration, 17.
Chatterbox, *see* Red-squirrel.
Cheek pouches, Kangaroo-rat, 425.
Chehalis, *see* Mountain Beaver.
Cherrie, George Kruck (1865–), of Field Museum on Porcupine war cry, 612.
Ches-se-kow-i-pis-kus, *see* Least Chipmunk.
Chewing cud, Opossum, 890.
chiapensis, Sylvilagus, 783.
Chicanot, E. L., on Beaver games, 482.
Chickadees use Rabbit fur for nests, 727.

Chickaree, *see* Red-squirrel.
- Fremont, *see* Squirrel, Fremont.
- Gray, *see* Squirrel, Fremont.
- Rocky Mountain, *see* Squirrel, Fremont.
- Western, *see* Squirrel, Douglas.

Chickens eaten by Franklin Ground-squirrel, 255.
- attacked by Striped Ground-squirrel, 239.

Chinisa, *see* Chipmunk.

Chip, Copper, *see* Chipmunk, Say's.
- Two-barred, *see* Chipmunk, Say's.

Chipmuck, *see* Chipmunk.

Chipmuk, *see* Chipmunk.

Chipmunk, Big, *see* Chipmunk, Common.
- Big, *see* Chipmunk, Say's.
- Common contents, 183; life, 184; den (ill.), 209; drawing (ill.), 190; early drawing (ill.), 194; genitalia (ill.), 209; glands (ill.), 203; map, 186; mastology (ill.), 203; poses (ill.), 198, 203; teeth, 184; and Weasel (ill.), 206.
- Eastern, *see* Chipmunk, Common.
- Golden, *see* Chipmunk, Say's.
- Least, contents, 169; life, 170; map, 186; pose (ill.), 178; teeth, 170; track (ill.), 178.
- Little, *see* Chipmunk, Least.
- Long-tailed, *see* Chipmunk, Least.
- Painted, *see* Chipmunk, Least.
- Rocky Mountain, *see* Chipmunk, Say's.
- Say's, contents, 217; life, 218; (ill.), 222; map, 252; skull (ill.), 236; teeth, 218.
- singing to sparrows (ill.), 214.
- Snow, *see* Chipmunk, Least.
- Two-striped, *see* Chipmunk, Say's.
- Western, *see* Chipmunk, Least.

Chippie, *see* Chipmunk.
- Grass, *see* Ground-squirrel, Striped.

Chips, Beaver (ill.) 492.

Christenson, Nancy, on Least Chipmunk pouches, 177.

Christy, Miller, English naturalist (1861–1928),
- on earthworms, 412.
- on age of European Hare, 663.
- on Least Chipmunk way of life, 177.
- on Rabbit plague, 710.
- on Striped Ground-squirrel as birdicide, 238.
- on Whitetailed Jack range, 651.

chrysodeirus, Callospermophilus, 219.

Chuck, *see* Woodchuck.

cinerascens, Callospermophilus, 219.
- Sylvilagus, 819.

cinerea, Neotoma, 504, 505.

cinereus, Mus, 504.

cinnamomina, Ondatra, 570.

Citelle, *see* Flickertail.

Citelle, Flag, *see* Ground-squirrel, Striped.
- de Franklin, *see* Ground-squirrel, Franklin.
- de Richardson, *see* Flickertail.
- Scrub, *see* Ground-squirrel, Franklin.
- à treize raies, *see* Ground-squirrel, Striped.

Citellus, *see* Flickertail.
- genus, 1, 228.
- alleni, 229.
- badius, 229.
- Franklin, *see* Ground-squirrel, Franklin.
- franklini, 250.

Citellus (*Continued*)
- franklinii, 250.
- hollisteri, 229.
- olivaceus, 229.
- pallidus, 229.
- parvus, 229.
- richardsoni, 260.
- richardsonii, 260.
- texensis, 229.
- Thirteen-striped, *see* Ground-squirrel, Striped.
- tridecemlineatus, 228, 229.
- tridecimlineatus, 228.

Clam-eating Muskrat 582.

Clark, Howard Walton (1870–   ), U. S. Biol. Sta., Iowa.
- on Muskrat parasites, 592.
- *see also* Evermann and Clark.

Clark, Capt. William (1770–1838), famous explorer, *see* Lewis & Clark.

Claw, Beaver double, 457.

Clements, J. E., on California Gray-squirrel voice, 62.

Climbing, *see also* Arboreal.
- Armadillo, 860.
- Mountain Beaver, 545.
- Muskrat, 581.
- Packrat, 513.
- Snowshoe Rabbit, 728.
- Swamp-rabbit, 824.

clusius, Thomomys talpoides, 397.

Cochetopa National Forest, Beaver numbers in, 447, 449.

cognatus, Sylvilagus, 783.

Coker, Robert Ervin (1876–   ), U. S. Bur. Fisheries, on Muskrat eating fish, frogs, etc., 583.
- on Muskrat and mussels, 582.

Cold sleep, Cottontail, 806.
- Opossum, 893.
- Red-squirrel, 148.
- Snowshoe Rabbit, 729.

Cole, Prof. Leon Jacob (1877–   ), Univ. Wis.,
- on pickerel eating Red-squirrel, 125.
- on Red-squirrel swimming, 120.

collaris, Ochotona, 637.

Collection, Packrat, 520.

Collett, Prof. Robert (1842–1913), naturalist. Zool. Mus., Christiania, Norway, on Lemming migration, 20.

Colloredo-Mannsfeld, Princess, imports Muskrats in Bohemia, 571.

Colonies, Mountain Beaver, 531.

Colorado, Opossum in, 870.

Colour, Abert, Squirrel, 68.
- Antelope Jack, 764.
- Apache Squirrel, 108.
- Arctic Hare, 668.
- Arizona Gray-squirrel, 112.
- Armadillo, 848.
- Beaver, 444.
- Big Flying-squirrel, 386.
- Blacktailed Jack, 736.
- Brush Rabbit, 818.
- California Gray-squirrel, 60.
- Chipmunk, 184.

Colour (*Continued*)
    Coney, 637.
    Cottontail, 782.
    Douglas Squirrel, 152.
    European Hare, 666.
    Flickertail, 260.
    Fox-squirrel, 82.
    Franklin Ground-squirrel, 250.
    Fremont Squirrel, 162.
    Gopher, 397.
    Gray-squirrel, 10.
    Greenland Hare, 682.
    Hoary Marmot, 352.
    Kangaroo-rat, 420.
    Least Chipmunk, 171.
    Little Flying-squirrel, 368.
    Marsh-rabbit, 830.
    Mountain Beaver, 527.
    Muskrat, 570.
    Opossum, 867.
    Opossum colour phases, 867.
    Packrat, 505.
    Porcupine, 605.
    Prairie-dog, 276.
    Pygmy Rabbit, 840.
    Red-squirrel, 118.
    Rockchuck, 338.
    Round-tailed Muskrat, 558.
    Say's Chipmunk, 218.
    Snowshoe Rabbit, 700.
    Striped Ground-squirrel, 229.
    Swamp-rabbit, 822.
    Whitetailed Jack, 649.
    Woodchuck, 301.
Colouration, directive and protective, Antelope Jack, 774.
    Blacktailed Jack, 749.
    Snowshoe Rabbit, 703.
    Whitetailed Jack, 654.
columbiana, Aplodontia, 528
columbianus, Thomomys talpoides, 398.
columbiensis, Glaucomys, 387.
    Lepus, 701.
Columbus *Gazette*, on Gray-squirrel numbers in Ohio, 21.
Combs made by Indians, of Porcupine tail, 628.
Comeau, Napoleon Alexander (1848–1923), Quebec naturalist, on Porcupine numbers, 608.
    on owl mistaking him for Rabbit, 725.
Communication, *see* Voice; *also* Glands.
Comparison, Cottontails, 781.
    Cottontail, Swamp-rabbit, and Marsh-rabbit, 822.
    Woodchuck, Rockchuck, and Hoary Marmot, 338.
Conaro, *see* Cottontail.
Coney, Contents, 635; Life, 636; and hay (ill.), 636; poses (ill.), 645; map, 639; feet (ill.), 645; head (ill.), 645; teeth, 636.
confinis, Eutamias, 172.
connectens, Sylvilagus, 783.
Connecticut, Cottontails in, 784.
    Opossum in, 869.
    Red-squirrel food in, 129.
    Whitetailed Jack in, 652.
Conservationist, on Cottontail numbers in U. S., 803.
consobrinus, Eutamias minimus, 171.
Constable, John of Adirondacks, on Porcupine scrap, 616.
Contents, Abert Squirrel, 67.
    Apache Squirrel, 107.
    Antelope Jack, 763.
    Arctic Hare, 667.
    Arizona Squirrel, 111.
    Armadillo, 847.
    Beaver, 441.
    Big Flying-squirrel, 385.
    Blacktailed Jack, 735.
    Brush Rabbit, 817.
    California Gray-squirrel, 59.
    Chipmunk, 183.
    Coney, 635.
    Cottontail, 779.
    Douglas Squirrel, 151.
    Flickertail, 259.
    Fox-squirrel, 81.
    Franklin Ground-squirrel, 249.
    Fremont Squirrel, 161.
    Gopher, 395.
    Gray-squirrel, 7.
    Greenland Hare, 681.
    Hoary Marmot, 351.
    Kangaroo-rat, 419.
    Least Chipmunk, 169.
    Little Flying-squirrel, 367.
    Marsh-rabbit, 829.
    Mountain Beaver, 525.
    Muskrat, 567.
    Opossum, 865.
    Packrat, 503.
    Porcupine, 603.
    Prairie-dog, 275.
    Pygmy Rabbit, 839.
    Red-squirrel, 115.
    Rockchuck, 337.
    Roundtailed Muskrat, 557.
    Say's Chipmunk, 217.
    Snowshoe Rabbit, 699.
    Striped Ground-squirrel, 227.
    Swamp-rabbit, 821.
    Whitetailed Jack, 647.
    Woodchuck, 299.
Cony, *see* Coney.
Cook, Albert John (1842–1916), biologist, on Chipmunk eating snake, 199.
Cooper, Dr. James Graham (1830–1902), Western naturalist,
    on Mountain Beaver names, 526.
    on Mountain Beaver out in snow-time, 547.
    on Mountain Beaver speed, 544.
    on Mountain Beaver swimming, 545.
    on Mountain Beaver trapping, 543.
    on Rabbit epidemic, 753.
Cooper, Rollin C., on damage by Flickertail, 269.
Cope, Edward Drinker (1840–1897), paleontologist,
    on Packrat and snake, 511.
    on Prairie-dog, owl, and rattler living together, 294.

Copper-callo, *see* Chipmunk, Say's.
Copperhead, *see* Chipmunk, Say's.
Copulation, Porcupine, 614.
Coquallin, *see* Fox-squirrel.
Corn, Kaffir, as Kangaroo-rat food, 425.
Corning, Hon Charles Robert, New Hampshire legislature, on Woodchuck character, 328.
Corsan, George Hebden, naturalist, Toronto,
  on Black-squirrel age, 56.
  on Gray-squirrel food, 29.
  on Gray-squirrel, tamability, 51.
Cory, Charles Barney (1857–1921), director Field Museum on Opossum in Illinois and Wisconsin, 870.
Cos Cob, Conn., Chipmunks at, 189, 190, 192, 193, 207, 210.
  Chipmunk storage at, 201.
Cottontail, Bachman's, *see* Rabbit, Brush.
Cottontail Common contents, 779; life, 781; bell (ill.), 805; feet (ill.), 805; horned (ill.), 811; map, 785; poses (ill.), 790; tail (ill.), 756; tracks (ill.), 750, 805, 798; young (ill.), 805.
  and Gray-squirrel game, 35.
  Molly, *see* Cottontail, common.
  Prairie-dogs bury, 296.
Cotztiocotequallin, *see* Fox-squirrel.
Coues, Dr. Elliott (1842–1899), ornithologist, etc., on Chipmunk at Pembina, 185.
  on Flickertail eating Buffalo, 269.
  on Flickertail numbers, 263.
  on Flickertail sociability, 265.
  on melano Prairie-dog, 277.
  on Prairie-dog, owl, and rattler living together, 294.
  on Whitetailed Jack borning, 656.
  on Whitetailed Jack broods, 657.
  on Whitetailed Jack range, 651.
  on Whitetailed Jack sociability, 654.
  on Whitetailed Jack way of life, 664.
Cougar, enemy to Beaver, 493.
  killed by Porcupine quills, 622.
  enemy to Prairie-dog, 295.
Couper, William, editor *Canadian Naturalist and Geologist*,
  on Beaver on Anticosti, 447.
  on Porcupine on Anticosti, 606.
  on Red-squirrel on Anticosti, 121.
Courage, *see* Bravery.
Cowper, William, English poet (1731–1800), on European Hare age, 663.
Cox, Prof. Ulysses Orange (1864–1920), biologist, Mankato, Minn., finds 15 little Flying-squirrels together, 372.
Cox, William Thomas (1878–), State Forester, Minn., on Porcupine damage to trees, 627.
Coyote, enemy to Antelope Jack, 772.
  enemy to Armadillo, 858.
  enemy to Blacktailed Jack, 751.
  enemy to Franklin Ground-squirrel, 257.
  enemy to Gopher, 405.
  enemy to Kangaroo-rat, 434.
  enemy to Packrat, 510.
  enemy to Prairie-dog, 295.
  enemy to Red-squirrel, 124.
Coyote (*Continued*)
  enemy to Rockchuck, 344.
  enemy to Say's Chipmunk, 224.
  enemy to Whitetailed Jack, 662.
Cozzens, Issachar, 1780–1865, of N. Y., on Porcupine numbers, 624.
Cram, William Everett (1871–), naturalist of Hampton Falls, N. H.,
  on Big Flying-squirrel sociability, 388.
  on Muskrat mother *vs.* Mink, 600.
  on Woodchuck bravery, 333.
  on Woodchuck digging own grave, 325.
  on Woodchuck escape by burrowing, 324.
  on Woodchuck harried by Fox, 324.
  on Woodchuck out late in season, 320.
  on Woodchuck paths to gardens, 308.
  on Woodchuck swimming, 312.
  on Woodchuck way of life, 331.
  on Woodchuck wintering in hollow log, 307.
Crawford, George, *see* Mittigwab.
Crawford, John, on Muskrat canal, 586.
Creosote no food for Kangaroo-rat, 426.
Crepuscular, Whitetailed Jack, 653.
  see also Nocturnal.
Cricetidæ Family, characteristics of, 3.
Cricetus talpoides, 396.
Criddle, Norman (1875–), naturalist of Treebank, Man., on Red-squirrel storage, 130.
Criddle, Stuart, brother of above, on Red-squirrel storage, 130.
Culver School, Ind., albino Red-squirrel at, 118.
Cunning, Cottontail, 793.
cuppes, Ochotona, 638.
Curiosity, Beaver, 480.
  Porcupine, 611.
  Striped Ground-squirrel, 235.
Curran, J. W., on Chipmunk swimming, 212.
Curtis, Capt. Paul A., Jr., on Woodchuck hunting, 330.
Cuterebra, in Chipmunk, 198.
  in Flickertail, 271.
  in Fox-squirrel, 103.
  in Gray-squirrel, 54.
  larva (ill.), 245.
  life history of, 54.
  in leg of man, 55.
  in Mouse (ill.), 209.
  in Red-squirrel, 126.
  in Striped Ground-squirrel, 242.
  in Whitetailed Jack, 663.
Cutting trees, Beaver, 458.
Cuvier, Frédéric (1773–1838), French naturalist, on Fox-squirrel names, 82.
Cuyler, W. Kenneth, of Austin, Tex., on albino Opossum, 867.
Cynomys
  genus, characteristics of, 2, 276.
  arizonensis, 277.
  gunnisoni 277.
  gunnisoni zuniensis, 278.
  leucurus, 277.
  ludovicianus, 276, 277.
  mexicanus, 277.
  parvidens, 277.
Cysts on Whitetailed Jack, 662.

DACOTA, Marmota, 339.
Dakota, North, Whitetailed Jack in, 650.
Whitetailed Jack numbers in, 653.
Dakota, South, Cottontails in, 786.
dakotensis, Sciurus, 118.
dalli, Lepus, 701.
Dam, Beaver, 460; (ill.), 486.
Damage, Beaver, 455.
  Cottontail, 790, 814.
  Gopher, 400.
  Mountain Beaver, 543.
  Porcupine, 616, 617, 625.
  Snowshoe Rabbit, 726.
  Woodchuck, 328.
Dance Hall, Kangaroo-rat, 429.
Daniels, Stewart, on Arizona Gray-squirrel migration, 113.
Darbey, Edward Wade, Winnipeg taxidermist,
  on Big Flying-squirrel broods, 392.
  on Flickertail burrow, 266.
  on number of Gopher mounds, 416.
Dartt, (E.) Mary (1842–), biographer of Mrs. M. A. Maxwell, (*q. v.*), on Porcupine playfulness, 613.
Darwin, Charles Robert (1809–1882), father of Darwinian Theory,
  on clover and old maids, 498.
  on earthworms, 412.
Dasypodidæ, Family, characteristics of, 5, 848.
Dasypus, genus, characteristics of, 5.
  fenestratus, 850.
  hoplites, 850.
  mexicanus, 850.
  novemcinctus, 848, 850.
  texanus, 850.
Davidson, J. L., on eagle *vs.* Porcupine, 623.
Davis, William Thompson (1862–), Bost. Soc. Nat. Hist., on Chipmunk eating moth, 199.
  on Gray-squirrel food, 28.
Daylight Beavers, 488.
  appearance of Mountain Beaver, 544.
De Benneville, Dr., his tame Cottontails, 807.
Deer, sanitation of, 138.
Deermouse, parasite of Red-squirrel, 126.
De la Barre, Antoine le Fèvre (1605–1688), Governor of Canada, 1682–85,
  on Indians and game laws, 499.
Delaware, Muskrat numbers in, 576.
Deming, Edwin Willard (1860–), artist,
  on Mink *vs.* Muskrat, 593.
Den, Armadillo, 854.
  Beaver, 469.
  Chipmunk, 191; (ill.), 209.
  Cottontail, 806.
  Flickertail, 266.
  Fox-squirrel, 93.
  Franklin Ground-squirrel, 253.
  Gopher, 407.
  Hoary Marmot, 356.
  Muskrat, 587; (ill.), 573, 579.
  Opossum, 873.
  Prairie-dog, 289.
  Pygmy Rabbit, 843.
Den (*Continued*)
  Rockchuck, 342.
  Woodchuck, 305.
Denver Museum has horned Cottontail, 787.
De Ong, Prof. E. Ralph, of Univ. Calif., on Cottontail disease, 800.
  on Rabbit parasites, 752.
Department of Interior, Ottawa, acknowledgment to, v.
Dermoid cysts, 728.
Dernier, George P., on Woodchuck cunning, 334.
  on Woodchuck voice, 314.
Desert, description of, 422.
  Dipo, *see* Kangaroo-rat.
deserti, Dipodomys, 420, 421.
deserticola, Lepus, 737.
Destruction of Flickertail, 271.
  Gray-squirrel, 24.
  Woodchuck, 330.
De Weese, Evans, takes horned Cottontail, 787.
Dice, Lee Raymond (1887–), zoologist, Univ. Mich., acknowledgment to, vi.
  on Big Flying-squirrels eating own tails, 391.
  on Beaver in Washington, 452.
  on Gray-squirrel in Michigan, 11.
  on Least Chipmunk food, 176.
  on Mink attacking Red-squirrel, 126.
  on Packrat eating bark, 518.
  on Red-squirrel food habits, 129.
  on Red-squirrel mating, 138.
  on Red-squirrel nests in Alaska, 137.
  on Red-squirrel storage, 130.
  on Red-squirrel voice, 144.
  on Snowshoe Rabbit broods, 720.
Dickerson, Miss Mary Cynthia (1866–1923), Zoologist, Amer. Mus. Nat. Hist., on Blacktailed Jack young, 742.
Dickey, Donald Ryder (1887–), zoologist, Pasadena, on Muskrat in California, 571.
Dickie, Francis, naturalist, Carberry, Man., on Flickertail mating, 266.
  on tailless Red-squirrel, 123.
  on Striped Ground-squirrel spring arrival, 232.
  on Whitetailed Jack weight, 649.
Dickinson, C. W., on Gray-squirrel migration, 17.
Didelphidæ Family, characteristics of, 5, 866.
Didelphis genus, characteristics of, 5, 866.
  marsupialis, 868.
  pigra, 867.
  virginiana, 866, 867.
Dipo, Desert, *see* Kangaroo-rat.
Dipo, Sprite of the Desert, 421.
Dipodomys, genus, characteristics of, 2, 420.
  deserti, 420, 421.
  sonoriensis, 421.
Disappearance of Chipmunks, 210.
Disease, Armadillo, 857.
  Beaver, 489.
  California Gray-squirrel, 65.
  Cottontail, 800.
  carried by Flickertail, 273.
  Gray-squirrel, 40.
  Marsh-rabbit, 833.
  Rockchuck, 344.

Disease (*Continued*)
Snowshoe Rabbit, 709.
Whitetailed Jack, 662.
Disposition, Fox-squirrel, 98.
Fremont Squirrel, 167.
Least Chipmunk, 179.
Little Flying-squirrel, 380.
Packrat, 512.
Woodchuck, 326.
Ditmars, Dr. Raymond Lee (1876–), curator Reptiles, N. Y. Zool. Park, on Beaver cutting trees, 459.
Diurnal Flickertail, 268.
Striped Ground-squirrel, [illegible].
see also Nocturnal.
Diving, Beaver, 472; (ill.), 492.
Cottontail, 795.
Muskrat, 580.
Dixon, Joseph (Scattergood) (1884–), zoologist, Univ. Calif., on Beaver in California, 452.
on Mountain Beaver enemies, 542.
on Muskrat shifting population, 575.
see also Grinnell, Joseph.
Dobson, Bert. A., Adirondack woodsman, and the Porcupine, 629.
Docks, Beaver, 465.
Muskrat, 591.
Dog, gestation and blind period, 44.
no enemy to Gray-squirrel, 52.
attacked by Porcupine, 622.
overcome by Woodchuck, 333, 335.
Dog-town, Prairie, 286.
Doherty, Paul, on Red-squirrel home range, 122.
Domestication, *see* Tamability.
Doorways closed, Kangaroo-rat, 430.
dorsata, Hystrix, 604.
dorsatum, Erethizon, 604, 605.
Doughty, J., and Thomas, on Porcupine numbers, 624.
Douglas, David (1798–1834), Scottish botanist, etc., collects first Brush-rabbit, 819.
traveller and botanist, 152.
Douglas Squirrel, *see* Squirrel, Douglas.
Douglasii, Lepus, 831.
douglasii, Sciurus, 152.
Thomomys, 397.
Downie, Dr. J. M., of San Antonio, Texas, on Fox-squirrel age, 106.
Drake, Samuel Gardener (1798–1875), American antiquarian,
on Indians and game laws, 499.
Drane, Robert, of Cardiff, Wales,
on European Hare eating own dung, 654.
on European Hare fighting, 740.
on European Hare voice, 747.
Drink, Blacktailed Jack, 748.
Flickertail, 270.
Franklin Ground-squirrel, 254.
Gopher, 402.
Gray-squirrel, 34.
Greenland Hare, [illegible].
Kangaroo-rat, 426.
Mountain Beaver, 536.
Opossum, 890.

Drink (*Continued*)
Snowshoe Rabbit, 716.
Striped Ground-squirrel, 242.
Woodchuck, 308.
Drive, Rabbit, 758; (ill.), 746.
Drowning, Big Flying-squirrel, 389.
Drummer-rat, *see* Packrat.
Drumming, Kangaroo-rat, 431.
Packrat, 512.
Red-squirrel, 140.
Snowshoe Rabbit, 733.
drummondii, Neotoma, 505.
Dthen, *see* Muskrat.
Duck as Fox-squirrel competitor, 104.
Duff's Lake, Man., Red-squirrel at, 121.
Dugas, trapper, quoted by Comeau, on Porcupine numbers, 609.
Dugmore, Major Arthur Radclyffe (1870–), English naturalist,
on Beaver numbers in Newfoundland, 450.
on outcast Beaver, 477.
on Beaver sexes, 443.
Dung, Antelope Jack (ill.), 777, 891.
Armadillo, 856; (ill.), 891.
Beaver, 490; (ill.), 631.
Big Flying-squirrel (ill.), 891.
Blacktailed Jack (ill.), 891.
Centipede (ill.), 631.
Chipmunk (ill.), 891.
Coney, 642; (ill.), 645, 891.
Cottontail (ill.), 891.
Deermouse (ill.), 631.
Fox-squirrel (ill.), 891.
Gopher, 407; (ill.), 403, 631.
Gray-squirrel, 38; (ill.), 631, 891.
House-mouse (ill.), 631.
House-rat (ill.), 631.
Kangaroo-rat, 428; (ill.), 435, 891.
Little Flying-squirrel (ill.), 631, 891.
Mountain Beaver, 540.
Muskrat (ill.), 589, 631; method of voiding, 591.
Opossum (ill.), 891.
Packrat (ill.), 514, 891.
Porcupine (ill.), 631.
Prairie-dog (ill.), 631.
Red-squirrel (ill.), 891.
Richardson Ground-squirrel (ill.), 631.
Rockchuck (ill.), 891.
Say's Chipmunk (ill.), 891.
Snowshoe Rabbit, 716; (ill.), 631.
Striped Ground-squirrel (ill.), 631.
Synaptomys cooperi (ill.), 631.
Vole, Drummond (ill.), 631.
Woodchuck (ill.), 631.
Dupont, General (Thomas) Coleman (1863–), Senator from Maryland, on Muskrat numbers, 575.
durangi, Sciurus, 69.
Dust Bath, Kangaroo-rat, 429.
Dusting place, Antelope Jack (ill.), 777.
Dyche, Prof. Louis Lindsay (1857–1915), zoologist on Franklin Ground-squirrel numbers, 251.
Dyed Chipmunk, 187.
Dynamite eaten by Porcupine, 610.

EAGLE, enemy to Beaver, 491.
  enemy to Blacktailed Jack, 751.
  enemy to Hoary Marmot, 361.
  enemy to Mountain Beaver, 542.
  enemy to Opossum, 893.
  enemy to Prairie-dog, 296.
  enemy to Rockchuck, 344.
  enemy to Whitetailed Jack, 661.
  full of Porcupine quills, 623.
Ear, Abert Squirrel, 71.
  Antelope Jack, 764, 766; (ill.), 756, 771.
  Arctic Hare (ill.), 756.
  Blacktailed Jack, 736, 743; (ill.), 756.
  Brush-rabbit (ill.), 756.
  Cottontail (ill.), 756.
  Greenland Hare, 696.
  Opossum, 867.
  Opossum frozen, 894.
  Packrat (ill.), 509.
  Pygmy Rabbit, 840; (ill.), 756.
  Snowshoe Rabbit (ill.), 756.
  Whitetailed Jack, 649; (ill.), 756.
  Woodchuck, 302.
Ear-bulbs, Kangaroo-rat, 433; (ill.), 432.
Earthworks, Gopher (ill.), 411.
Earthworms, 412.
Eastman, Dr. Charles Alexander (1858–), Sioux Indian, Ohiyesa,
  on Indians and Chipmunk, 210.
  on Muskrat storing wapato, 585.
Eating huts, Muskrat, 590.
Eaton, Prof. Elon Howard (1866–), biologist, Hobart Coll.,
  on Gray-squirrel migration, 17.
Ebner, Urban Spring, on Flickertail weight, 260.
Écureuil à treize raies, *see* Ground-squirrel, Striped.
  de Franklin, *see* Ground-squirrel, Franklin.
  de la Baie d'Hudson, *see* Red-squirrel.
  de Richardson, *see* Flickertail.
  gris et noir, *see* Gray-squirrel.
  roux, *see* Red-squirrel.
  volant, *see* Flying-squirrel, Big.
Edentata Order, characteristics of, 5.
Edwards, George (1693–1773), English naturalist, on Woodchuck names, 300.
Egede-Saabye, Hans (1686–1758), "The Apostle of Greenland," Norwegian missionary, on Greenland Hare numbers in Greenland, 685.
Egg-eater, *see* Red-squirrel.
Eifrig, C. E., of Ottawa, on owl *vs.* Porcupine, 623.
Eisenhard, Captain George, of Culver School, Ind., on albino Red-squirrel, 118.
Elliot, Daniel Giraud (1835–1915), director Field Museum,
  on Mountain Beaver haymaking, 539.
Ely, Dr. W. W., of Rochester, N. Y., on Beaver glands, 481.
Emasculation by cuterebra, 55.
  of Gray-squirrel by Red-squirrel, 147.
  of Striped Ground-squirrel, 244.
Emlen, Arthur Cope, of Phila., Pa., on Muskrat fighting boy, 594.
Emmons, Dr. Ebenezer (1798–1863), naturalist of Mass.,
  on Fox-squirrel in Massachusetts, 84.
Enemies, Antelope Jack, 770.
  Arctic Hare, 673.
  Armadillo, 857.
  Beaver, 490.
  Big Flying-squirrel, 390.
  Blacktailed Jack, 751.
  Chipmunk, 196.
  Coney, 644.
  Cottontail, 797.
  Flickertail, 271.
  Fox-squirrel, 103.
  Franklin Ground-squirrel, 257.
  Gopher, 405.
  Gray-squirrel, 51.
  Greenland Hare, 695.
  Hoary Marmot, 360.
  Kangaroo-rat, 434.
  Marsh-rabbit, 833.
  Mountain Beaver, 542.
  Muskrat, 592.
  Opossum, 892.
  Packrat, 510.
  Porcupine, 624.
  Prairie-dog, 295.
  Red-squirrel, 123.
  Rockchuck, 344.
  Roundtailed Muskrat, 564.
  Say's Chipmunk, 224.
  Snowshoe Rabbit, 723.
  Striped Ground-squirrel, 242.
  Whitetailed Jack, 660.
  Woodchuck, 323.
engelhardti, Marmota, 339.
English, Pennoyer F., of Texas Coll., on Packrat mating, 517.
  on Packrat nests, 515.
  on Packrat young, 517.
Engstrom, Hannah, on Chipmunk eating Mouse, 199.
epixanthum, Erethizon, 605.
eremicus, Lepus, 737.
Erethizon, genus, characteristics of, 4, 604.
  dorsatum, 604, 605.
  epixanthum, 605.
  picinum, 605.
Erethizontidæ Family, characteristics of, 4, 604.
Ermine, enemy to Greenland Hare, 695.
  see also Weasel.
Europe, Muskrat in, 571.
European Hare, *see* Hare, European.
Eutamias, genus, characteristics of, 1, 170.
  alpinus, 170.
  amoenus, 170.
  confinis, 172.
  grisescens, 172.
  jacksoni, 172.
  minimus arizonensis, 172.
  minimus atristriatus, 172.
  minimus borealis, 172.
  minimus cacodemus, 171.
  minimus caniceps, 172.
  minimus caryi, 171.
  minimus consobrinus, 171.
  minimus minimus, 170, 171.
  minimus neglectus, 172.

Eutamias (*Continued*)
minimus operarius, 171.
minimus oreocetes, 172.
minimus pallidus, 171.
minimus pictus, 171.
quadrivittatus, 170.
townsendii, 170.
Evans, Wallace, of St. Charles, Ill., game farm, on Mink and Cottontail living together, 797.
Everglades, Gray-squirrel in, 13.
Evermann, Dr. Barton Warren (1853–), biologist, Calif. Acad. Sci. Mus., on Muskrat parasites, 592.
see also Evermann & Clark.
Evermann & Clark, on Little Flying-squirrel broods, 378.
on Little Flying-squirrel flight, 375.
on Little Flying-squirrel nesting place, 375.
on Little Flying-squirrel numbers, 371.
on Little Flying-squirrel nursery life, 380.
on Little Flying-squirrel sociability, 372.
exiguus, Sylvilagus, 819.
extimus, Sciurus, 11.
Eyesight, Armadillo, 853.
Cottontail, 804.

FABRICIUS, Rev. Otho (1744–1822), Danish missionary to Greenland, and naturalist, on Greenland Hare breeding, 691.
Falcon, enemy to Blacktailed Jack, 751.
Falling of Gray-squirrel, 37.
Family, American Mouse, characteristics of, 3.
Aplodontiidae, 3.
Armadillo, 5.
Beaver, 3, 443.
Castoridæ, 3, 443.
Cricetidæ, 3.
Dasopodidæ, 5, 848.
Didelphidæ, 5, 866.
Erethizontidæ, 4, 604.
Geomyidæ, 2, 396
Heteromyidæ, 2, 420.
Leporidæ, 4, 648.
Marmot, 1.
Mole-gopher, 2
Mountain Beaver, 3.
Ochotonidæ, 4, 636.
Opossum, 5.
Pika, 4.
Pocket Jumping-mouse, 2.
Porcupine, 4.
Rabbit, 4.
Sciuridæ, 1, 9.
Squirrel, 1, 9.
Family Life, Beaver (ill.), 454.
Chipmunk, 195.
Flickertail, 268.
Fox-squirrel, 95.
Gray-squirrel, 46.
Hoary Marmot, 357.
Kangaroo-rat, 436.
Little Flying-squirrel, 380.
Red-squirrel, 144.
Woodchuck, 316.
Fanakla, *see* Fox-squirrel.
Fani Okchako, *see* Gray-squirrel.
Fanitasho, *see* Gray-squirrel.
Farming, Beaver, 454.
Father Beaver, 476.
Fox-squirrel, 95.
Red-squirrel, 139.
Fear, in Blacktailed Jack, 747.
in Red-squirrel, 125.
Feet, Arctic Hare (ill.), 676.
Armadillo, 849; (ill.), 859.
Beaver, 457; (ill.), 456.
Blacktailed Jack (ill.), 719.
California Gray-squirrel (ill.), 64.
Coney (ill.), 645.
Cottontail (ill.), 805.
Fox-squirrel (ill.), 97.
Gopher, 404; (ill.), 403.
Hoary Marmot (ill.), 362.
Kangaroo-rat (ill.), 432.
Marsh-rabbit, 830.
Muskrat (ill.), 573.
Opossum, 866, 867; (ill.), 886.
Packrat (ill.), 509.
Red-squirrel (ill.), 131.
Rockchuck (ill.), 346.
Snowshoe Rabbit, 703; (ill.), 719.
Swamp-rabbit, 823.
Whitetailed Jack (ill.), 659.
Woodchuck (ill.), 311, 317.
Feilden, Major Henry Wemyss, of the Nares Expedition, 1875–76,
on Greenland Hare breeding, 691.
fenestratus, Dasypus, 850.
fenisex, Ochotona, 638.
Fernald, John S., of Belfast, Me., on Gray-squirrel escaping Dogs and Cats, 52.
Ferocity, *see* Fighting.
Ferret, Blackfooted, enemy to Prairie-dog, 296.
ferreus, Sciurus, 69.
festinus, Lepus, 737.
Field-mice, sanitation of, 138.
Figgins, Jesse Dade ( ), of Colo. Mus. Nat. Hist., 339.
figginsi, Ochotona, 637.
Fighting, Gray-squirrel, 42.
Mountain Beaver, 548.
Muskrat, 594.
Snowshoe Rabbit, 718.
Finnie, Oswald Sterling (1876–), director N.W.T. & Y. Branch, Dept. Int., Ottawa, acknowledgment to, v.
Fire, Wild, enemy to Porcupine, 624.
Fish, enemy to Gray-squirrel, 53.
enemy to Muskrat, 593.
enemy to Red-squirrel, 125.
Fisher, enemy to Beaver, 491.
enemy to Gray-squirrel, 52.
enemy to Mountain Beaver, 542.
enemy to Porcupine, 609, 624.
Fisher, Dr. Albert Kenrick (1856–), U. S. Biol. Surv., finds Big Flying-squirrel nest, 392.
on cuterebra, 55.
on cuterebra in Chipmunk, 198.
on hawks and owls *vs.* Gopher, 405.

Fisher (*Continued*)
on hawk as enemy to Kangaroo-rat, 434.
on Prairie-dog damage, 283.
on hawks and owls *vs.* Red-squirrel, 124.
on Rabbit damage, 760.
Fisher, Alexander, Surg. R. N., Hecla & Griper Arctic Exped., 1819–1820.
on Arctic Hare weight, 668.
on Greenland Hare numbers on Melville Id., 686.
Fisher, Dr. (George) Clyde (1878–), curator Dept. Pub. Educ., Amer. Mus. Nat. Hist., acknowlegdment to, vi.
on Chipmunk mating, 193.
on Gray-squirrel tamability, 51.
Fisher, William Hubbell, of Cincinnati, O., on Woodchuck dens, 306.
finds Woodchuck skull in burrow, 325.
his photos of Woodchuck burrows (ill.), 329.
fisheri, Tamias, 185.
Fitch, Dr. Asa (1809–1878), N. Y. State entomologist, investigates cuterebra, 54.
on Gray-squirrel numbers in N. Y., 17.
Flag Citelle, *see* Ground-squirrel, Striped.
Flag Squirrel, *see* Ground-squirrel, Striped.
flavigularis, Lepus, 766.
flaviventer, Arctomys, 338.
Marmota, 338.
flaviventris, Glaucomys, 388.
Marmota, 338, 339.
Fleming, James Henry (1872–), of Toronto, his belled Cottontail, 786.
on first Cottontails at Toronto, 784.
Flesh, Armadillo, 862.
Beaver, 454.
Cottontail, 788.
Fox-squirrel, 105.
Hoary Marmot, 354.
Marsh-rabbit, 834.
Muskrat, 578.
Packrat, 508.
Porcupine, 628.
Snowshoe Rabbit, 726.
Woodchuck, 313.
Flickertail, contents, 259; life, 260; burrow (ill.), 267; map, 262.
Flight, Big Flying-squirrel, 389.
Little Flying-squirrel, 375.
"Florida Correspondent," on Gray-squirrel burying and digging up nuts, 31.
floridanus, Lepus sylvaticus, 781.
Sylvilagus, 781, 782.
Flying-squirrel, Big, contents, 385; life, 386; (ill.), 390; map, 370; poses (ill.), 376.
Canadian, *see* Flying-squirrel, Big.
Little, contents, 367; life, 368; map, 370; poses (ill.), 376; teeth, 368.
Northern, *see* Flying squirrel, Big.
sanitation of, 138.
Severn River, *see* Flying-squirrel, Big.
Southern, *see* Flying-squirrel, Little.
White-furred, *see* Flying-squirrel, Little.
Food, Abert Squirrel, 77.
Apache Squirrel, 109.
Arctic Hare, 673.
Food (*Continued*)
Arizona Gray-squirrel, 113.
Armadillo, 855.
Beaver, 483.
Big Flying-squirrel, 390.
Blacktailed Jack, 748.
California Gray-squirrel, 61
Chipmunk, 198.
Coney, 642.
Cottontail, 789.
Douglas Squirrel, 155.
Flickertail, 269.
Fox-squirrel, 88.
Franklin Ground-squirrel, 255.
Fremont Squirrel, 166.
Gopher, 401.
Gray-squirrel, 28.
Gray-squirrel young, 46.
Greenland Hare, 689.
Hoary Marmot, 355.
Kangaroo-rat, 424.
Least Chipmunk, 176.
Little Flying-squirrel, 373.
Marsh-rabbit, 833.
Mountain Beaver, 536.
Muskrat, 581.
Opossum, 888.
Packrat, 518.
Porcupine, 615.
Prairie-dog, 282.
Red-squirrel, 128.
Rockchuck, 342.
Roundtailed Muskrat, 563.
Say's Chipmunk, 221.
Snowshoe Rabbit, 716.
Striped Ground-squirrel, 237.
Swamp-rabbit, 824.
Whitetailed Jack, 654.
Woodchuck, 308.
Footing self, Beaver, 488.
Forbush, Edward Howe (1858–), Mass. State Ornithologist, on Gray-squirrel broods, 46.
on Gray-squirrel numbers in Massachusetts, 25.
on Red-squirrel second brood, 142.
Fordyce, George Lincoln, (1860–), zoologist of Youngstown, Ohio, on Fox-squirrel haunts, 87.
on Gray-squirrel migration, 18.
Forest regions of U. S. (map), 174.
Forest & Stream, acknowledgment to, v.
Form or bed, Antelope Jack, 769.
Arctic Hare, 675.
Blacktailed Jack (ill.), 766.
Cottontail, 803.
Greenland Hare, 696.
fortirostris, Marmota, 339.
fossor, Thomomys, 397.
Foster, B. E., of Biol. Surv., Phoenix, Ariz., on construction of Prairie-dog laterals, 289.
Foster, G. M., of Glasgow, Ky.
on Cat adopting Gray-squirrel, 47.
Foster, H. M., cattle-man of N. M., tries to drown Prairie-dogs, 288.
Fottler, John, of Boston, Mass., on Snowshoe Rabbit voice, 732.

Fountain, Paul (1849–   ), Northern traveller on Gray-squirrel numbers in Michigan, 23.
Fox, enemy to Arctic Hare, 673.
  enemy to Big Flying-squirrel, 390.
  enemy to Blacktailed Jack, 751.
  enemy to Franklin Ground-squirrel, 257.
  enemy to Gopher, 405.
  enemy to Gray-squirrel, 52.
  enemy to Greenland Hare, 695.
  enemy to Kangaroo-rat, 434.
  enemy to Muskrat, 593.
  enemy to Prairie-dog, 296.
  enemy to Whitetailed Jack, 662.
  enemy to Woodchuck, 323.
  killed by Porcupine quills, 622.
Fox-squirrel, Apache, *see* Squirrel, Apache.
  Canyon, *see* Gray-squirrel, Arizona.
  compared with Gray-squirrel, 9.
  contents, 81; life, 82; feet (ill.) 97; map, 85; track (ill.), 97.
  in Missouri, 26.
Franklin Ground-squirrel, *see* Ground-squirrel, Franklin.
Franklin, Sir John (1786–1847), of Arctic fame, 250.
  on Eskimos licking objects, 91.
franklini, Citellus, 250.
franklinii, Arctomys, 250.
  Citellus, 250.
Freak Rabbit, Cottontails, 786.
Freak foot, Muskrat, 578.
Freezing, Abert Squirrel, 71, 76.
  Cottontail, [illegible].
  Gray-squirrel, 50.
  Whitetailed Jack, 653.
Fremont, Capt. John Charles (1813–1890), "The Pathfinder of the West," collects Fremont Squirrel, 162.
Fremont Squirrel, *see* Squirrel, Fremont.
Fremont's Squirrel, *see* Squirrel, Fremont.
fremonti, Sciurus, 162.
French, John C., on Gray-squirrel numbers in Penn., 18.
Frierson, L. S., of Gayle, La., on Armadillo in Louisiana, 852.
Frightened to death, Cottontail, 796.
Frog, enemy to Chipmunk, 197.
  food of Chipmunk, 197, 199.
frondator, Castor, 444.
Fryxell, Fritiof Melvin, geologist, Univ. Chicago.
  on Gray-squirrel migration, 19.
  on Little Flying-squirrel numbers, 371.
Fuertes, Louis Agassiz (1874–1927), artist-naturalist, Ithaca, N. Y., on Little Flying-squirrel sociability, 384.
fuliginosus, Glaucomys, 387.
  Sciurus, 11.
fulvus, Thomomys, 397.
fumosa, Ochotona, 638.
Fungi as Packrat food, 518.
  see also Mushrooms.
Fur, Beaver, 454.
  Cottontail, 788.
  Flickertail, 271.
  Greenland Hare, 682.
Fur (*Continued*)
  Hoary Marmot, 353.
  Muskrat, 577.
  Packrat, 508.
  Snowshoe Rabbit, 727.
  Woodchuck, 312.
Fur trade in Canada, 451.
  Beaver, 449.
  Muskrat, 576.
fusca, Neotoma, 505.
fuscus, Thomomys, 397.

G., F. G., on Muskrat numbers in Louisiana, 576.
gaillardi, Lepus, 765.
Gait, Greenland Hare, 695.
  Opossum, 882.
  Pygmy Rabbit, 843.
Games, Beaver, 482.
  Fox-squirrel, 99.
  Gray-squirrel, 35.
  Greenland Hare, 695.
  Muskrat, 581.
  Red-squirrel, 144.
  Squirrels and Cottontail, 812.
  Woodchuck, 319.
Ganado, Ariz., Abert Squirrel near, 73, 76.
Garcelon, Dr. Harris (1868–   ), of Victorville, Calif., on Blacktailed Jack numbers, 757.
  on Kangaroo-rat ears, 433.
  on Kangaroo-rats far from home, 433.
  on Rabbit epidemic, 753.
Garland, Hamlin, novelist (1860–   ), Cottontail nest and young at home of, 810.
  on hawk *vs.* Whitetailed Jack, 660.
Gaufre, *see* Gopher.
  gris, *see* Gopher.
Gaut, James Hamilton, 1879–1914, zoologist, Texas Biol. Surv., on Opossum food, 890.
  on Opossum numbers in Texas, 871.
Genitalia, Chipmunk (ill.), 209.
Gentry, Thomas George (1843–1905), ornithologist, Phila., Pa., on Red-squirrel and owl living together, 146.
Genus Aplodontia, 3, 526.
  Brachylagus, 5, 840.
  Callospermophilus, 1, 218.
  Castor, 3, 443.
  Citellus, 1, 228.
  Cynomys, 2, 276.
  Dasypus, 5.
  Didelphis, 5, 866.
  Dipodomys, 2, 420.
  Erethizon, 4, 604.
  Eutamias, 1, 170.
  Geomys, 396.
  Glaucomys, 2, 368.
  Homodontomys, 504.
  Lepus, 4, 648.
  Marmota, 2, 301.
  Neofiber, 3, 558.
  Neotoma, 3, 504.
  Ochotona, 4, 636.
  Ondatra, 3, 569.
  Sciurus, 1, 9.
  Sylvilagus, 4, 781.

Genus (*Continued*)
Tamias, 1, 184.
Teonoma, 504.
Thomomys, 2, 396.
Geological Survey Museum, Canada, Gray-squirrel in, 11.
Geomyidæ Family, characteristics of, 2, 396.
Geomys genus, characteristics of, 396.
Gestation, Abert Squirrel, 74.
Beaver, 473.
Blacktailed Jack, 745.
Chipmunk, 194.
Cottontail, 808.
Gray-squirrel, 44.
Ground-squirrel, 266.
Little Flying-squirrel, 378.
Mountain Beaver, 542.
Muskrat, 598.
Opossum, 875.
Rabbit, 266.
Snowshoe Rabbit, 720.
Whitetailed Jack, 656.
Ghost Rabbit, 796.
Gianini, Charles Alfred, of Poland, N. Y.,
on Woodchuck eating June bugs, 309.
on Woodchuck game, 319.
on Woodchuck way of life, 333.
Gibbs, George (1815–1873), of the 47th Parallel Survey, 1853–55,
on Mountain Beaver haymaking, 538.
on use of Mountain Beaver to Indians, 543.
on Mountain Beaver voice, 551.
on Rabbit epidemic, 753.
Gillette, Prof. Clarence P. (1859–), Director Exper. Sta., Ft. Collins, Colo., on Striped Ground-squirrel food, 237.
Gilliss, Miss Julia S., of Cheyenne, Wyo. on Prairie-dog holes, 288.
on melano Prairie-dog, 277.
on Prairie-dogs as pets, 292.
Gilmore, Dr. Melvin Randolph (1868–), ethnozoologist, Heye Mus., N. Y., on Prairie-dog names, 276.
Gilpin, Dr. John Bernard (1810–1892),
on Gray-squirrel in Nova Scotia, 13.
Glands, Beaver, 481.
Chipmunk (ill.), 203.
Cottontail, 789.
Gray-squirrel, 40.
Kangaroo-rat, 431; (ill.), 432.
Mountain Beaver, 544.
Muskrat, 586.
Packrat, 512.
Woodchuck, 313.
Glaucomys genus, characteristics of, 2, 368.
alpinus, 387.
bangsi, 387.
bullatus, 387.
californicus, 388.
canescens, 387.
columbiensis, 387.
flaviventris, 388.
fuliginosus, 387.
goldmani, 369.
klamathensis, 387.

Glaucomys (*Continued*)
lascivus, 388.
latipes, 387.
macrotis, 387.
makkovikensis, 387.
olympicus, 387.
oregonensis, 387.
querceti, 369.
sabrinus, 386, 387.
saturatus, 369.
stephensi, 388.
texensis, 369.
volans, 368, 369.
yukonensis, 387.
zaphæus, 387.
Glennon, Tom, on Chipmunk eating Mouse, 200.
Godman, Dr. John Davidson (1794–1830), of Phila.,
on Gray-squirrel migration, 16.
on Woodchuck ear, 302.
on Woodchuck food, 309.
on Woodchuck sanitation, 325.
on Woodchuck tamability, 326.
on Woodchuck *vs.* Cat, 333.
Goff, John B., guide, Flattops, Cols., on Gopher activity, 410.
Golden Gate Park, San Francisco, Gopher numbers in, 400.
Goldman, Major Edward Alphonso (1873–), zoologist, U. S. Biol., Surv.,
acknowledgment to, vi, vi.
on species of Neotoma, 504.
on Rabbit damage, 761.
goldmani, Glaucomys, 369.
Goldsmith, Oliver (1728–1774), English poet, on parasites, 592.
Goodwin, George Gilbert (1894–), mammologist, Amer. Mus. Nat. Hist.,
on Big Flying-squirrel voice, 389.
on number of Porcupine quills, 620.
on Snowshoe Rabbit voice, 732.
on Woodchuck numbers, 304.
Gopher, contents, 395; life, 396; (ill.), 396; burrow (ill.), 406, 409, 415; burrowing (ill.), 406; dung (ill.), 403; earthworks (ill.), 411; feet (ill.), 403; poses (ill.), 403; map, 399.
Gray, *see* Gopher.
Gray, *see* Ground-squirrel, Franklin.
Mole, *see* Gopher.
Pocket, *see* Pocket-gopher.
Scrub, *see* Ground-squirrel, Franklin.
Striped, *see* Ground-squirrel, Striped.
misnomer for Striped Ground-squirrel, 228.
sanitation of, 138.
Whistling, *see* Ground-squirrel, Franklin.
Yellow, *see* Flickertail.
Graham, Maxwell (1872–1927), Chief, Wild Life Div., N. W. T. &. Y. Branch, Ottawa, acknowledgment to, v.
Graham, Sir Richard, on European Hare voice, 746.
grahamensis, Sciurus, 163.
Grant, Mrs. J. M., on Prairie-dog killed by yellow-jacket, 295.
on Prairie-dog throwing self on back, 297.

Grass Chippie, *see* Ground-squirrel, Striped.
Grasshoppers eaten by Flickertail, 269.
Grass-runner, *see* Ground-squirrel, Striped.
Gray-back, *see* Gray-squirrel.
Grayfox, enemy to Gray-squirrel, 52.
  enemy to Mountain Beaver, 542.
Gray-squirrel, contents, 7; life, 9; adopted by Cat (ill.), 46; feet (ill.), 22; planting (ill.), 14; poses (ill.), 54; map, 12; teeth, 9; nest (ill.), 39; mastology (ill.), 22.
  compared with Fox-squirrel, 82.
  haunts compared with Fox-squirrel, 86.
  inhabits Red-squirrel nest, 147.
Gray-squirrel, Arizona, contents, 111; life, 112; map, 85.
Gray-squirrel, California, contents, 59; life, 60, feet (ill.), 64; map, 12; skull (ill.), 64.
  Canyon, *see* Gray-squirrel, Arizona.
  Russian, 25.
  Saddle-backed, *see* Squirrel, Abert.
  West Coast, *see* Gray-squirrel, California.
  Western, *see* Gray-squirrel, California.
Greely, Gen. Adolphus Washington (1844–), U. S. A., the Arctic explorer,
  on Greenland Hare food, 691.
  on Greenland Hare gait, 696.
  on Greenland Hare range, 685.
Green, Morris M. (1870–), zoologist, on Cottontail in Michigan, 784.
  on Striped Ground-squirrel killing chickens, 239.
  on Striped Ground-squirrel pouches, 241.
Green, S. S., on muskallonge eating Red-squirrel, 125.
Green, Thomas L., Postmaster West Union, Ia., on Whitetailed Jack in Iowa, 651.
Greenback, *see* Squirrel, Fremont.
Greenland Hare, *see* Hare, Greenland.
Greenwich, Conn., Chipmunks at, 190, 191, 193, 210, 211.
Grieve, George, taxidermist of Winnipeg,
  on Snow-shoe Rabbit years, 706.
Grinnell, Dr. George Bird (1849–), of Forest & Stream,
  on value of Beaver as irrigator, 496.
  on Flickertail young, 268.
Grinnell, Prof. Joseph (1877–), zoologist Univ. Calif., on Coney personality, 641.
  on Mountain Beaver damage, 543.
  on Opossum in California, 871.
Grinnell (J.) & Dixon (J.), on Say's Chipmunk broods, 224.
  on Say's Chipmunk burrow, 223.
  on Say's Chipmunk enemies, 224.
  on Say's Chipmunk food, 221.
  on Say's Chipmunk haunts, 220.
  on Say's Chipmunk storage, 222.
  on Say's Chipmunk voice, 223.
  on Say's Chipmunk weight, 219.
  on Say's Chipmunk young, 224.
grisescens, Eutamias, 172.
griseus, Sciurus, 60.
  Tamias, 185.
Grizzly *vs.* Beaver, 493.
  opens Hoary Marmot den, 356.
Grizzly (*Continued*)
  as Hoary Marmot enemy, 360.
  as Rockchuck enemy, 344.
groenlandicus, Lepus, 682.
Groundhog, *see* Woodchuck.
  Gray, *see* Marmot, Hoary.
  Yellow, *see* Rockchuck.
Groundhog Day, 321.
Groundpig, *see* Woodchuck.
Ground-squirrel, enemy to Mountain Beaver, 542; sanitation of, 138.
  Barking, *see* Prairie-dog.
  Big, *see* Flickertail; *also* Woodchuck.
  Bushy-tailed, *see* Ground-squirrel, Franklin.
  Franklin, contents, 249; life, 250; (ill.), 254; map, 252; enemy to Snowshoe Rabbit, 724.
  Golden-mantled, *see* Chipmunk, Say's.
  Gray, *see* Ground-squirrel, Franklin.
  Richardson, *see* Flickertail.
  Side-striped, *see* Chipmunk, Say's.
  Striped, *see also* Chipmunk.
  Striped, contents, 227; life, 228; (ill.), 238; burrow (ill.), 245; map, 230; playground (ill.), 245; skull (ill.), 236; teeth, 228.
  Yellow, *see* Flickertail.
Grubb, C. L., sportsman of Fitchburg, Mass., on Gray-squirrel numbers in Mass., 25.
Guernsey, George F., of Fort Qu'appelle, Sask., on Whitetailed Jack range, 651.
Gulls eat Red-squirrel, 125.
Gunn, Frank L., on Cat adopting Gray-squirrel, 47.
gunnisoni, Cynomys, 277.
gymnicus, Sciurus, 118.
Gyrfalcon, enemy to Arctic Hare, 673.
Gyroscope, Kangaroo-rat, 433.

HABITS, Brush-rabbit, 820.
  Marsh-rabbit, 834.
  Pygmy Rabbit, 842.
Hackee, *see* Chipmunk.
Hackey, *see* Chipmunk.
Hahn, Walter Louis (1879–), zoologist, Mitchell, Ind.,
  on Gray-squirrel storing acorns, 31.
  on Woodchuck eating sassafras, 308.
  on Woodchuck numbers, 304.
Hall, Hon. Joseph James (1874–), sportsman of Denver, Colo., on Beaver leaping, 472.
  on Beaver locating leaks, 461.
Hamby, Charles H., on Packrat *vs.* snake, 511.
Hanbury, David T., explorer of Northern Canada, on Arctic Hare young, 677.
Hanford, D. R., on Snowshoe Rabbit mother and young, 721.
Hang-kasha, *see* Woodchuck.
Haplodon, *see* Mountain Beaver.
Harding, Christy, H. B. Co. factor, Ft. Resolution, on two Rabbits taken in one snare, 728.
Hardy, Manly (1832-1910), hunter-naturalist of Brewer, Me.,
  on Beaver footing self, 488.
  on Muskrat caught with meat and fish, 584.
  on owl seizing his head, 724.
  on animals killed by Porcupine quills, 622.
  on Snowshoe Rabbit eating fish, 717.

Hardy, W. Manly, on Muskrats fighting for mates, 597.
Hare, Alpine, *see* Arctic Hare.
  Alpine, of the Danes, *see* Greenland Hare.
  Arctic, contents, 667; life, 668; feet (ill.), 67; head (ill.), 672; map, 684; skull (ill.), 693.
  Belgian, immune from plague, 713.
  Calling, *see* Coney.
  European, life, 665.
  Glacier, *see* Hare, Greenland.
  Great White, *see* Hare, Greenland.
  Greenland, contents, 681; life, 682, map, 684; skull (ill.), 693; drawing, frontispiece.
  Jackass, *see* Blacktailed Jack.
  Little Chief, *see* Coney.
  Meadow, *see* Whitetailed Jack.
  Mountain, *see* Whitetailed Jack.
  Mouse, *see* Coney.
  Northern, *see* Snowshoe Rabbit.
  Polar, *see* Hare, Greenland.
  Prairie, *see* Whitetailed Jack.
  Rocky Mountain, *see* Whitetailed Jack.
  Swamp, *see* Rabbit, Swamp.
  Swansdown, *see* Hare, Greenland.
  Texan, *see* Blacktailed Jack.
  Texas, *see* Antelope Jack.
  Townsend's, *see* Whitetailed Jack.
  Varying, *see* Snowshoe Rabbit.
  White, *see* Snowshoe Rabbit.
  Wood, *see* Cottontail.
Hargest, Judge, of Harrisburg, Pa., on Gray-squirrel storage, 31.
Harkin, Hon. James Bernard (1875–), Comm. of Dominion Parks, Dept. Int., Ottawa, Canada, acknowledgment to, v.
Harmon, Daniel Williams (1778–1845), fur trader and explorer of B. C.,
  on Hoary Marmot names, 352.
  on Hoary Marmot skin, 353.
  on Hoary Marmot voice, 357.
  on Hoary Marmot young, 358.
Harper, Dr. Francis (1886–), zoologist, Bost. Soc. Nat. Hist., acknowledgment to, vi.
  on Opossum in New Hampshire, 869.
  on Roundtailed Muskrat breeding, 563.
  on Roundtailed Muskrat enemies, 564.
  on Roundtailed Muskrat nest, 562.
  on Roundtailed Muskrat numbers, 561.
  on Roundtailed Muskrat parasites, 564.
  on Roundtailed Muskrat range, 559.
Harris, Nelson, Adirondack hunter, on Snowshoe Rabbit swimming, 716.
Harrison, Richard, of Blunt, So. Dak., on Prairie-dog numbers in South Dakota, 281.
Harrison, Robert M., of Grand Rapids, Mich., on Woodchuck family life, 316.
Harting, James Edmund (1841–1928), English naturalist, on English Rabbit family life, 722.
Hartman, Dr. Carl (1879–), embryologist, Johns Hopkins Univ., acknowledgment to, vi.
  on Opossum colour mutations, 867.
  on Opossum reproduction, 877.
  on Packrat and snakes, 511.
Hartwell, Caroline M., of Spring Valley, N. Y., on Chipmunk as birdicide, 200.
Harvey, Dr. George W., of Paradise, Calif., on Porcupine full of Porcupine quills, 623.
Hats of Beaver or silk?, 498.
Haunts, Abert Squirrel, 69.
  Antelope Jack, 767.
  Arctic Hare, 670.
  Armadillo, 852.
  Beaver, 448.
  Big Flying-squirrel, 388.
  Blacktailed Jack, 738.
  California Gray-squirrel, 61.
  Chipmunk, 187.
  Coney, 638.
  Cottontail, 786.
  Douglas Squirrel, 153.
  Flickertail, 261.
  Fox-squirrel, 86.
  Franklin Ground-squirrel, 251.
  Fremont Squirrel, 163.
  Gopher, 398.
  Gray-squirrel, 13.
  Greenland Hare, 689.
  Hoary Marmot, 354.
  Kangaroo-rat, 422.
  Least Chipmunk, 173.
  Little Flying-squirrel, 369.
  Marsh-rabbit, 831.
  Mountain Beaver, 529.
  Muskrat, 574.
  Opossum, 871.
  Packrat, 506.
  Porcupine, 606.
  Prairie-dog, 278.
  Pygmy Rabbit, 841.
  Red-squirrel, 121.
  Rockchuck, 340.
  Roundtailed Muskrat, 559.
  Say's Chipmunk, 220.
  Snowshoe Rabbit, 704.
  Striped Ground-squirrel, 231.
  Swamp-rabbit, 823, 826.
  Whitetailed Jack, 652.
  Woodchuck, 303.
Hawk, enemy to Blacktailed Jack, 751.
  enemy to Franklin Ground-squirrel, 257.
  enemy to Gopher, 405.
  enemy to Gray-squirrel, 51.
  enemy to Kangaroo-rat, 434.
  enemy to Muskrat, 592.
  enemy to Opossum, 893.
  enemy to Packrat, 510.
  enemy to Prairie-dog, 296.
  enemy to Red-squirrel, 124.
  enemy to Striped Ground-squirrel, 242.
  enemy to Whitetailed Jack, 660, 661.
Hawkins, Col. L. L., of Portland, Ore., on Whitetailed Jack swimming, 658.
Haybarn, Coney, 641; (ill.), 642, 645.
Haymaker, *see* Coney.
Haymaking, Mountain Beaver, 538.
Hays, William, engineer on Great Slave River steamer, on shifting population of Muskrats, 575.

Hayt-kah-lah, *see* Chupmunk.
Head, Arctic Hare (ill.), 672.
  Coney (ill.), 645.
  Hoary Marmot (ill.), 362.
  Kangaroo-rat (ill.), 432.
  Woodchuck (ill.), 317, 322.
Hearne, Samuel (1745–1792), famous for his journey to the Polar Sea,
  on Arctic Hare food, 673.
  on Arctic Hare penis, 669.
  on Arctic Hare weight, 668.
  on black Beaver, 444.
  on Beaver dung, 490.
  on Beaver food, 484.
  on multiplex Beaver lodge, 471.
  on Beaver young, 474.
  on Porcupine as food, 628.
  on Porcupine home range, 606.
  on Porcupine mating, 614.
  on Wolverine *vs.* Beaver, 491.
Hedgehog, *see* Porcupine.
Heller, Edmund (1875–), zoologist, Field Museum, on Hoary Marmot hibernation, 363.
Hemlock, poison, eaten by Beavers, 484.
Hendee, Russell, W., *see* Bailey, Alfred M.
Henry, Alexander, II (circa 1770–1814), famous explorer and fur trader,
  on Beaver disappearance, 489.
  on *Ixodes*, 725.
  on Whitetailed Jack range, 650.
Henry, Dr. T. J., of Apollo, Pa., on Chipmunk borning and young, 194.
  on Chipmunk winter life, 213.
Hermit, *see* Walton, M. A.
Hernandez, Francisco (1514–1578), historian of Mexico, on Fox-squirrel names, 82.
Herrick, Clarence Luther (1858–1904), neurologist, Univ. Cincinnati,
  on Franklin Ground-squirrel food, 255.
  on Gopher storage, 401.
  on Porcupine feeding habits, 616.
Hertzberg, Dr. Reinhold (1874–), of Stamford, Conn., on tame Flying-squirrels, 383.
Heteromyidæ Family, characteristics of, 2, 420.
Hibernation, Abert Squirrel, 76.
  Big Flying-squirrel, 393.
  California Gray-squirrel, 65.
  Chipmunk, 208, 212.
  Coney, 644.
  Douglas Squirrel, 154.
  Flickertail, 274.
  Fox-squirrel, 102.
  Franklin Ground-squirrel, 257.
  Gopher, 412.
  Gray-squirrel, 35.
  Hoary Marmot, 363.
  Kangaroo-rat, 430.
  Least Chipmunk, 180.
  Mountain Beaver, 547.
  Opossum, 893.
  Porcupine, 610.
  Prairie-dog, 291.
  Red-squirrel, 148.
  Rockchuck, 347.
Hibernation (*Continued*)
  Say's Chipmunk, 224.
  Striped Ground-squirrel, 237, 244.
  Woodchuck, 319.
  see also Cold Sleep.
Hicks, Prof. Frederick C., of Cincinnati, Ohio, on Cottontail running to man for protection against Weasel, 798.
Hildreth, Dr. Samuel Prescott (1783–1863), historian of Ohio, on Gray-squirrel migration, 16.
Him-mal-e-ga-ta, *see* Squirrel, Fremont.
Hinckley, George Walter, of Hinckley, Me. (1853–), on Gray-squirrel in Maine, 13.
Hind, Prof. Henry Youle (1823–1908), of Can. Geol. Surv.
  on Snowshoe Rabbit years, 705, 706.
  on Whitetailed Jack range, 651.
Hine, William Rochfort, former taxidermist of Winnipeg,
  on Beaver weight, 444.
  on cuterebra in Red-squirrel, 126.
  his albino Snowshoe Rabbit, 701.
  on Snowshoe Rabbit year, 709.
History, Armadillo, 850.
  Brush-rabbit, 819.
  European Hare, 665.
  Kangaroo-rat, 422.
  Marsh-rabbit, 831.
  Mountain Beaver, 528.
  Opossum, 868.
  Roundtailed Muskrat, 558.
hitchensi, Sylvilagus, 782.
Hoary Marmot, *see* Marmot, Hoary.
Hodges, F. R., on Gray-squirrel and snake, 53.
Hofer, Thomas Elwood, guide of Yellowstone Park, captures Beaver, 444.
Hoffecker, Jim, takes 3,200 Muskrats, 576.
Hofmann, Dr. Julius Valentine, on Least Chipmunk value to man, 177.
Hoh-cush-a, *see* Woodchuck.
Holliday, T. L., on Porcupine damage to Dogs, 626.
Hollis, Edwin, English naturalist, on Franklin Ground-squirrel family life, 254.
  on Least Chipmunk storage, 177.
Hollister, Ned (1876–1924), Director Nat. Zoo on Gray-squirrel numbers in National Zoo, 36.
  on Hoary Marmot numbers, 354.
  on Hoary Marmot voice, 357.
  on Prairie-dog races, 277.
  on Prairie-dog weight, 276.
hollisteri, Citellus, 229.
Holt, Ernest G., of Carnegie Mus., Pittsburgh, Pa., on Woodchuck overcoming Dogs, 333.
holzneri, Sylvilagus, 783.
Home, Big Flying-squirrel, 392.
  Little Flying-squirrel, 375.
  Mountain Beaver, 533.
  Rockchuck, 342.
Home love, Chipmunk, 192.
  Packrat, 516.
Home Range, Antelope Jack, 768.
  Beaver, 448.
  Big Flying-squirrel, 388.

Home Range (*Continued*)
    Blacktailed Jack, 740.
    California Gray-squirrel, 61.
    Chipmunk, 187.
    Cottontail, 786.
    Flickertail, 264.
    Fox-squirrel, 86.
    Franklin Ground-squirrel, 251.
    Gopher, 400.
    Gray-squirrel, 13.
    Greenland Hare, 688.
    Least Chipmunk, 173.
    Little Flying-squirrel, 369.
    Muskrat, 572.
    Opossum, 872.
    Porcupine, 606.
    Prairie-dog, 278.
    Snowshoe Rabbit, 704.
    Red-squirrel, 121.
    Whitetailed Jack, 652.
    Woodchuck, 304.
Homodontomys genus, characteristics of, 504.
Hoofed Muskrat, 578; (ill.), 573.
hoplites, Dasypus, 850.
Hornaday, Dr. William Temple (1854–), formerly director of N. Y. Zool. Park, on Snowshoe Rabbit disease, 713.
Horned Cottontails, 787; (ill.), 811.
Horton, Charles H., of St. Johnsbury, Vt., on trout breaking off Red-squirrel's tail, 123.
Ho-tang, *see* Ground-squirrel, Franklin.
Houghton, John N., of Grinnell, Ia., on Striped Ground-squirrel eating butterflies and cutworms, 237.
    on Striped Ground-squirrel numbers, 231.
Houses, Muskrat (ill.), 589.
Howell, Alfred Brazier (1886–), zoologist, U. S. Nat. Mus., acknowledgment to, vi.
    on Coney young, 644.
    on Douglas Squirrel haunts, 153.
    on Packrat glands, 512.
    on Rockchuck haunts, 340.
    on Rockchuck range, 340.
Howell, Arthur Holmes (1872–), zoologist U. S. Biol. Surv., acknowledgment to, v, vi.
    on Coney species, 636.
    on Fox-squirrel haunts, 87.
    on Fox-squirrel in Maryland, 84.
    on Hoary Marmot hibernation, 363.
    on melano Hoary Marmot, 353.
    on Hoary Marmot weight, 352.
    on Least Chipmunk races, 170.
    on Rockchuck breeding, 343.
    on Rockchuck hibernation, 348.
    on melano Rockchuck, 339.
    on Rockchuck carrying spotted fever, 345.
    on Rockchuck weight, 338.
    on Rockchuck spring appearance, 348.
    on Roundtailed Muskrat food, 564.
    on Roundtailed Muskrat haunts, 559.
    on Roundtailed Muskrat tunnels, 561.
    on spotted fever, 274.
    on Swamp-rabbit ground habits, 825.
    on Woodchuck climbing, 310.
    on melano Woodchuck, 302.
Howell, Benjamin Franklin, 3rd (1890–), geologist, Princeton Univ., on gulls eating Red-squirrel, 125.
Howle, T. Peter, of Richmond, Va., on Beaver in Virginia, 452.
Hoy, Dr. Philo Romayne (1816–1892), of Racine, Wis.,
    on Chipmunk climbing, 212.
    on Franklin Ground-squirrel food, 255.
    on Gray-squirrel migration, 17.
    on Gray-squirrel numbers, 23.
    on Striped Ground-squirrel hibernation, 246.
    on Striped Ground-squirrel food, 239.
    on Striped Ground-squirrel young, 234.
huachuca, Sciurus, 112.
Hubbard, C. Andreson, of Seattle, Wash.,
    on Mountain Beaver breeding, 541.
    on Mountain Beaver burrows, 533.
    on Mountain Beaver testes, 527.
hudsonicus, Sciurus, 117, 118.
Hudson's Bay Co., on Beaver, 449.
humboldtiana, Aplodontia, 528.
Humphrey, Andrew A., on Mississippi Survey, 418.
Humphrey & Abbott, on Mississippi mud, 418.
Hunt, L. F., an old-timer of Iowa, on Fox-squirrel attacked by bees, 104.
Hunter, Thomas, and Flying-squirrel carrying off lighted candles, 391.
Hunting Arctic Hare, 678.
    Cottontail, 788.
    Fox-squirrel, 99.
    Woodchuck, 330.
Huron, Lake, Gray-squirrel at, 11.
hypophæus, Sciurus, 11.
Hystrix dorsata, 604.

IDAHOENSIS, Brachylagus, 840.
    Lepus, 840.
    Thomomys talpoides, 398.
ignava, Marmota, 303.
Illinois, Cottontail numbers in, 802.
    Gray-squirrel migration in, 19.
    Opossum in, 870.
Implantations of Cottontails, 801.
incana, Ochotona, 638.
Indiana, Fox-squirrel in, 121.
    Red-squirrel in, 121.
Indians hunt Chipmunks, 208.
Industry, Gopher, 410.
Ingalls, Leoren D., of Vermont, on Fox *vs.* Woodchuck, 324.
    on Woodchuck weight, 301.
Insects, enemies to Antelope Jack, 772.
    enemies to Blacktailed Jack, 752.
    enemies of Chipmunk, 198.
    enemies of Cottontail, 800.
    as Kangaroo-rat food, 427.
    see also Parasites.
insularis, Lepus, 738.
Intelligence, Arctic Hare, 678.
    Beaver, 485.
    Opossum, 882.
    Porcupine, 610.
    Red-squirrel, 147.

Intelligence (*Continued*)
Snowshoe Rabbit, 729.
Striped Ground-squirrel, 234.
Woodchuck, 326.
Iowa, Cottontail numbers in, 802.
Opossum in, 870.
Striped Ground-squirrel in, 231.
Whitetailed Jack in, 651.
Irrigator, Beaver as an, 496.
Irving, George W., of Waterville, N. Y., on Cat adopting Gray-squirrel, 47.
Isbister, William, Hudson's Bay Co. factor at Nelson River House, on Porcupine numbers, 608.
Ixodes, enemy to Snowshoe Rabbit, 725.
enemy to Striped Ground-squirrel, 242.
enemy to Whitetailed Jack, 663.

JACK, ANTELOPE, *see* Antelope Jack.
Blacktailed, contents, 735; life, 736; (ill.), 742; crouching (ill.), 766; feet (ill.), 719; form (ill.), 766; map, 739; spy-hop (ill.), 750; tail (ill.), 756 ; tracks (ill.), 750.
Blanket, *see* Antelope Jack.
Burro, *see* Antelope Jack.
Californian, *see* Jack, Blacktailed.
Donkey, *see* Antelope Jack.
Gray-sided, *see* Jack, Blacktailed.
Kansas, *see* Jack, Blacktailed.
Mexican, *see* Antelope Jack.
Texas, *see* Jack, Blacktailed.
White, *see* Jack, Whitetailed.
White-flanked, *see* Antelope Jack.
White-sided, *see* Antelope Jack.
Whitetailed, contents, 647; life, 648; feet (ill.), 659; map, 684; poses (ill.), 655; spy-hop (ill.), 750; tail (ill.), 756; teeth, 648; tracks (ill.), 750.
Jackrabbit, *see* Jack.
Jackson, Cicero Floyd (1887–), Univ. N. H.,
on Beaver numbers in New Hampshire, 451.
on Cottontail in New Hampshire, 784.
on Porcupine numbers in New Hampshire, 608.
Jackson, Dr. Hartley Harrad Thompson (1881–), zool. U. S. Biol. Surv. acknowledgment to, v, vi.
on Abert Squirrel young, 74.
on Gray-squirrel migration, 18.
on Porcupine curiosity, 611.
on Whitetailed Jack in Wisconsin, 652.
on Woodchuck climbing, 310.
Jackson, M. B., Game Conserv., on Muskrat in British Columbia, 571.
Jackson, P. K., kills 147 Gray-squirrels in one day, 28.
jacksoni, Eutamias, 172.
Jacob or California woodpecker, 61.
Jaeger, Edmund C., (1887–), of Riverside, Calif., on Packrat and warbles, 511.
Jefferson, J. R., Chief Game Warden of Austin, Tex., on Fox-squirrel hunt, 99.
Jetties, Muskrat, 591.
Jewett, Stanley Gordon (1885–), U. S. Biol.

Jewett (*Continued*)
Surv. of Portland, Ore., acknowledgment to, v.
colour of his Pygmy Rabbit, 840.
Jillson, Samuel, on Franklin Ground-squirrel den, 253.
on Franklin Ground-squirrel food, 255.
Johnny Bow-an'-arrow, Beaver caller, 480.
Johnson, Dr. Arthur M., of Minneapolis, Minn.,
on Franklin Ground-squirrel eating Rabbit, 256.
on Snowshoe Rabbit killed by Franklin Ground-squirrel, 724.
Johnson, Dr. Charles Eugene (1880–), zoologist, State Coll. Forestry, Syracuse, N. Y., acknowledgment to, vi.
on Beaver in Minnesota, 452.
on Beaver numbers in New York, 451.
on Beaver teats, 443.
on Beaver underwater stay, 473.
on Muskrat broods, 599.
on Muskrat numbers in New York, 576.
on Muskrat parasites, 592.
on Porcupine food, 617.
on Red-squirrel food in Minnesota, 129.
on Whitetailed Jack swimming, 660.
on Woodchuck swimming, 312.
Jones, Prof. Marcus Eugene (1852–), botanist, Salt Lake City, on Rabbit epidemic, 752.
Jones, Dr. Nelson Edward (1821–1901), historian of Ohio,
on Rabbit slaughter, 757.
on Squirrel hunters, 57.
Jones, Thomas M., of Harrisburg, Pa.,
on Gray-squirrel eating peanuts, 29.
on Gray-squirrel storage, 31.
Josselyn, John (1529–1603), ancient chronicler of New England on Chipmunk numbers, 190.
Judd, Elmer T., of Cando, No. Dak., on Flickertail numbers, 263.
Jumper, *see* Kangaroo-rat.
Jumping, Gray-squirrel, 38.
Red-squirrel, 143.

KABAN, FRANK A., of Seattle, Wash., on Beaver eating poison hemlock, 484.
Ka-choh, *see* Arctic Hare.
Kagh, *see* Porcupine.
Kah, *see* Snowshoe Rabbit.
Kahk, *see* Porcupine.
kaibabensis, Sciurus, 69.
Kain, Conrad, mountain guide, of Wilmer, B. C., on Hoary Marmot numbers, 354.
Kalm, Peter (1715–1779), Swedish botanist,
on Gray-squirrel migration, 16.
on Gray-squirrel numbers in Penn., 21.
Kane, Dr. Elisha Kent (1820–1857), Arctic explorer, 1853–1855,
on Greenland Hare food, 690.
on Greenland Hare range, 685.
Kangaroo-rat, contents, 419; life, 420; (ill.), 422; burrow (ill.), 435; dung (ill.), 435; feet (ill.); 432; glands (ill.), 432; head (ill.), 432; map,

Kangaroo-rat (*Continued*)
279; skull (ill.), 432; teeth, 420; tracks (ill.), 432.
Big, *see* Kangaroo-rat.
Kansas, Beaver in, 452.
Kathan, Dexter W., of Putney, Vt., gets Opossum in Vermont, 869.
Kee-hah-chah, *see* Red-squirrel.
Kee-hua Cahl-a, *see* Packrat.
Keewatin, Least Chipmunk in, 172.
Kellogg, Dr. Albert, of Sacramento, Calif., on Woodchuck song, 315.
Kellogg, Miss Louise, on Mountain Beaver burrows, 535.
on Mountain Beaver haymaking, 539.
Kennicott, Dr. John A., of Buffalo, N. Y., on Gray-squirrel migration, 15.
Kennicott, Robert (1835–1866), naturalist of West Northfield, Ill.,
on Chipmunk climbing, 212.
on Chipmunk den, 191.
on Chipmunk food, 198.
on Chipmunk hibernation, 214.
on Chipmunk sociability, 196.
on Chipmunk storage, 206.
on Cottontail broods, 808.
on Cottontail burrows, 804.
on Cottontail cunning, 793.
on Cottontail fighting, 806.
on Cottontail forms, 804.
on Cottontail parasites, 800.
on Cottontail *vs.* hawk, 813.
on Cottontail *vs.* snake, 812.
on Cottontail voice, 789.
on Fox-squirrel activity, 100.
on Fox-squirrel eating corn, 90.
on Fox-squirrel eating sap, 89.
on Fox-squirrel games, 99.
on Fox-squirrel haunts, 87.
on Fox-squirrel home life, 96.
on Fox-squirrel nest and young, 94.
on Fox-squirrel shyness, 99.
on Fox-squirrel storing in forks of trees, 92.
on Fox-squirrel travelling 5 miles, 98.
on Fox-squirrel voice, 103.
on number of Fox-squirrel young, 95.
on Franklin Ground-squirrel den, 253.
on Franklin Ground-squirrel haunts, 251.
on Franklin Ground-squirrel mating, 254.
on Franklin Ground-squirrel migration, 256.
on Franklin Ground-squirrel sociability, 253.
on Gray-squirrel broods, 46.
on Gray-squirrel food, 28.
on Gray-squirrel migration, 14.
on Little Flying-squirrel nest, 377.
on Little Flying-squirrel sociability, 372.
on Marsh-rabbit, 831.
on Mink *vs.* Cottontail, 797.
on Striped Ground-squirrel family life, 244.
on Striped Ground-squirrel food, 239.
on Striped Ground-squirrel mating, 232.
on Striped Ground-squirrel sociability, 231.
on Striped Ground-squirrel storage, 241.
on Striped Ground-squirrel value to man, 247.
on Striped Ground-squirrel young, 234.
Kennicott (*Continued*)
on Swamp-rabbit haunts, 823.
on Swamp-rabbit high perches, 825.
on Whitetailed Jack range, 651.
Kenora, number of Red-squirrel at, 119.
Kentucky, Gray-squirrel numbers in, 21.
Kick-willy, *see* Mountain Beaver.
Kildon, Rev. E. R., of Loyal, Wis., on Cat *vs.* Chipmunk, 197.
King, Charles, of Frontenac, Minn., on Cottontail swimming, 795.
King, Prof. F. H., on Little Flying-squirrel tamability, 381.
Kinney, John C., ranchman of Tucson, Ariz., on Antelope Jack caught by Coyote stratagem, 772.
on Antelope Jack numbers, 768.
Kinney, Rev. George Rex Boyer, U.C.C., B.C. traveller,
on Hoary Marmot numbers, 354.
Kinships, Cottontail, 781.
Kirk, George L., of Rutland, Vt., on Beaver in Vermont, 451.
on Opossum in Vermont, 869.
Kit-chee Wah-boos, *see* Jack, Whitetailed.
Kitchi-adjudamo, *see* Gray-squirrel.
Kittson, T. S., of Manitoba, on owl eating Big Flying-squirrel, 390.
klamathensis, Glaucomys, 387.
Lepus, 702.
Klee-ay, *see* Red-squirrel.
Klugh, Prof. Alfred Brooker (1882–), Queen's Univ., Kingston, Ont.,
on Chipmunk food, 199.
on Chipmunk storing pebbles, 206.
on Red-squirrel carrying potatoes, 143.
on Red-squirrel game, 144.
on Red-squirrel jumping power, 143.
on Red-squirrel stealing potatoes, 133.
on Red-squirrel storage, 134.
on Red-squirrel tunnels in snow, 148.
Kocher, J. R., of San José, Calif., introduces Opossum into California, 870.
Koll-che-ow-eh, *see* Squirrel, Fremont.
Kuskoquim River, Mink attacks Red-squirrel at, 126.

L., S. P., on Cottontail's high-strung nerves, 795.
Labrador, Porcupine numbers in, 608.
labradorius, Lepus, 760.
Labyrinths, Kangaroo-rat, 428.
Lagomorpha Order, characteristics of, 4.
Lagomys princeps, 636.
Lahontan, Baron de (Armand Louis de Delondarce (1667–1715), French representative in Canada, on Opossum, 868.
Lambert, Henry, on Flickertail *vs.* Weasel, 273.
Lampson, Sir Curtis M., of London fur sales, on Beaver, 449.
Landing places, Beaver, 465.
Lang, Herbert (1879–), zoologist, Amer. Mus. Nat. Hist. on Fox-squirrel carrying young, 95.
Langdon, Dr. Frank Warren, of Cincinnati, Ohio (1852–), on Woodchuck climbing, 310.

Lange, Prof. Dietrich (1863–), of St. Paul, Minn., on Gray-squirrel young and nest, 44.
Lano, Albert, of Fayetteville, Ark., on eagle *vs.* Porcupine, 623.
Lantz, Dr. David Ernest (1855–1918), U. S. Biol. Surv., on Blacktail Jack damage, 748.
    on Cottontail eating incense cedar, 790.
    on feeding Cottontails in winter, 792.
    on Kangaroo-rat cheek pouches, 425.
    on Kangaroo-rat storing 2 bushels of wheat, 425.
    on Mountain Beaver damage, 543.
    on Muskrat as food, 578.
    on Muskrat fur trade, 576.
    on Muskrat litters, 599, 599.
    on Muskrat numbers, 577.
    on Prairie-dog home tree, 286.
Lapin, *see* Snowshoe Rabbit.
lascivus, Glaucomys, 388.
lateralis, Callospermophilus, 218, 219.
    Sciurus, 218.
Latham, C. F., of Micco, Fla., on Roundtailed Muskrat numbers, 561.
    on Roundtailed Muskrat swimming, 564.
latipes, Glaucomys, 387.
Laurie (perhaps Lawrie), Andrew J., of Chattanooga, Okla., Kangaroo-rat stores 2 bushels of his wheat, 425.
Lawrence, George Newbold ([illegible]), ornithologist of N. Y., on Roundtailed Muskrat numbers, 561.
Leaks in Beaver dams, 461.
Leaping, Abert Squirrel, 71.
    Beaver, 472.
    Gray-squirrel, 36.
Least Chipmunk, *see* Chipmunk, Least.
Lee, Major J. M., on Swamp-rabbit numbers, 824.
Legislature of New Hampshire, on Woodchuck, 328.
Leighly, Ernest O., of Hartville, Ohio, on Woodchuck eating quail, 309.
Leighton, Alexander H., of Rosemont, Pa., on Porcupine shooting quills, 621.
lemhi, Ochotona, 637.
Lemming migration, 20.
Leopold, F. A., on Woodchuck sagacity, 332.
Leporidæ Family, characteristics of, 4, 648.
Lepus genus, 4, 648.
    alleni, 764, 765.
    altamiræ, 766.
    americanus, 700, 701.
    aquaticus, 822.
    arcticus, 668, 670.
    asellus, 737.
    bachmani, 818.
    bairdii, 701.
    bangsii, 670.
    battyi, 765.
    bennettii, 737.
    bishopi, 701.
    californica, 736.
    californicus, 736, 737.
    callotis, 765.
    campanius, 650.
Lepus genus (*Continued*)
    cascadensis, 701.
    canus, 670.
    columbiensis, 701.
    dalli, 701.
    deserticola, 737.
    Douglasii, 831.
    eremicus, 737.
    festinus, 737.
    flavigularis, 766.
    gaillardi, 765.
    groenlandicus, 682.
    idahoensis, 840.
    insularis, 738.
    klamathensis, 702.
    labradorius, 670.
    macfarlani, 701.
    magdalenæ, 738.
    martirensis, 738.
    melanotis, 737.
    merriami, 737.
    othus, 670.
    palitans, 765.
    palustris, 830.
    phæonotus, 701.
    poadromus, 670.
    princeps, 636.
    richardsonii, 737.
    sierræ, 650.
    struthopus, 701.
    sylvaticus floridanus, 781.
    texianus, 737.
    tiburonensis, 765.
    townsendii, 648, 650.
    virginianus, 701.
    wallawalla, 737.
    washingtonii, 702.
    xanti, 738.
leucodonta, Castor, 445.
leucotis, Sciurus, 10.
leucurus, Cynomys, 277.
levis, Ochotona, 637.
Lewis, Capt. Meriwether (1774–1809), & Clark, Capt. William, of the famous expedition up the Missouri and to the Pacific (1804–1806),
    on Beaver cutting trees, 459.
    in troduce Mountain Beaver to literature, 528.
    on Whitetail Jack sociability, 654.
    on Whitetail Jack speed, 657.
Lice *vs.* Beaver, 493.
Liebre, *see* Blacktailed Jack.
Lièvre, *see* Whitetailed Jack.
Lièvre arctique d'Amérique, *see* Arctic Hare.
    d'Amérique, *see* Snowshoe Rabbit.
Lights fascinate Rabbits to their death, 728.
Ligon, James Stokley (1879–), forester, of Santa Fe, N. M., acknowledgment to, vi.
    on Prairie-dog, hibernation, 291.
limitis, Sciurus, 83.
Linnæus, Carolus (1707–1778), Great Swedish naturalist, names Woodchuck, 300.
Lion, Mountain, *see* Cougar.
Litters, *see* Broods.
littoralis, Sylvilagus, 823.
Little, Etta V., on Opossum in California, 870.

Little, Dr. William Seelye (1867–), of Rochester, N. Y., on Snowshoe Rabbit plague, 712.
Lizards eaten by Armadillo, 856.
  eaten by Striped Ground-squirrel, 238.
Lodge, Beaver, 470; (ill.), 486.
  multiplex Beaver, 471.
  Muskrat, 588.
Long, Major Stephen Harriman (1784–1864), discoverer of Long's Peak, 1820, on Beaver cutting trees, 460.
Long Island, N. Y., Opossum on, 809.
loquax, Sciurus, 118.
Lord, John Keast (1818–1872), naturalist to Br. N. A. Boundary Comm.,
  on Hoary Marmot burrows, 356.
  on Hoary Marmot home life, 358.
  on Mountain Beaver enemies, 542.
  on Mountain Beaver life history, 529.
  on Mountain Beaver voice, 552.
Loring, John Alden (1871–), ornithologist, Owego, N. Y., acknowledgment to, vi.
  on Hoary Marmot young, 358.
  on Least Chipmunk food, 176.
  on marsh-hawk *vs.* Blacktailed Jack, 751.
  on Muskrat eating clams, 582.
Louisiana, Armadillo in, 852.
  Cottontail numbers in, 802.
  Muskrat numbers in, 576.
Lovell, Hervey, on Woodchuck bravery, 333.
Lowell, A. C., of Fort Bidwell, Calif., on Rabbit disease, 752.
lucida, Neotoma, 505.
ludoviciana, Arctomys, 276.
ludovicianus, Cynomys, 276, 277.
Lum, S. K., on Mountain Beaver enemies, 542.
  on Mountain Beaver haunts, 530.
  on Mountain Beaver hibernation, 547.
  on Mountain Beaver life history, 529.
  on Mountain Beaver voice, 551.
  on Mountain Beaver water control, 535.
luteola, Marmota, 339.
lutescens, Ochotona, 637.
lychnuchus, Sciurus, 163.
Lynx, enemy to Beaver, 491.
  enemy to Gray-squirrel, 52.
  enemy to Packrat, 510.
  enemy to Rockchuck, 344.
  killed by Porcupine quills, 622.
  vs. Porcupine (ill.), 626.
Lyon, Capt. George Francis (1795–1832), of the *Hecla* (1821–23), on Arctic Hare food, 673.
Lyon, Marcus Ward, Jr. (1875–), U. S. Nat. Mus., on Mountain Beaver haymaking, 538.
lysteri, Tamias, 185.

MacCURDY, W. W. H., on Rabbit drive, 759.
MacFarlane, Roderick (Ross), (1833–1920) Hudson's Bay Co. factor, Ft. Anderson,
  on Arctic Hare numbers, 671.
  on Snowshoe Rabbit young, 720.
macfarlani, Lepus, 701.
Mackenzie, Sir Alexander (1755–1820), discoverer of Mackenzie River (1789), on Indian names, 636.
Macmillan, Donald Baxter, Arctic explorer on Greenland Hare numbers, 685.
Macoun, James Melville (1862–1920), of Can. Geol. Surv., Ottawa,
  on Flickertail numbers, 263.
Macoun, Prof. John (1831–1920), of Can. Geol. Surv., father of the above,
  on Big Flying-squirrel in trout, 390.
  on Flickertail enemies, 271.
  on Snowshoe Rabbit years, 706.
MacPherson, Hugh Alexander, Br. naturalist, on European Hare voice, 747.
macrodon, Ondatra, 570.
macrotis, Glaucomys, 387.
madrensis, Callospermophilus, 220.
magdalenæ, Lepus, 738.
Mah-hee-ah-cha, *see* Gopher.
Mah-steen-cha, *see* Snowshoe Rabbit.
Mah-steen-cha Tung-ka, *see* Whitetailed Jack.
Mahs-tin-shkah, *see* Whitetailed Jack.
Mah-stin-cha la, *see* Snowshoe Rabbit.
Maine, Beaver numbers in, 451.
  Cottontail in, 784.
  Gray-squirrel in, 13.
  Porcupine numbers in, 608.
makkovikensis, Glaucomys, 387.
Mallard's voice like Gray-squirrel's, 40.
Mallon, John F., expert on Muskrat fur trade, 576.
mallurus, Sylvilagus, 782.
Mammæ, Armadillo, 848.
Manitoba, Beaver numbers in, 450.
  Chipmunk in, 185.
  Cottontail in, 786.
  Flickertail in, 261.
  Least Chipmunk in, 173.
  Porcupine numbers in, 606.
  Red-squirrel numbers in, 119.
  Striped Ground-squirrel in, 231.
  Whitetailed Jack in, 650.
Manniche, Arner Ludwig Valdemar, Nat. of N. E. Greenland Exped., 1906–08,
  on Greenland Hare fearlessness, 692.
  on Greenland Hare feeding habits, 690.
  on Greenland Hare food, 689.
  on Greenland Hare gait, 696.
  on Greenland Hare game, 695.
  on Greenland Hare haunts, 689.
  on Greenland Hare mating and young, 691.
  on Greenland Hare migration, 689.
  on Greenland Hare moult, 683.
  on Greenland Hare nocturnalism, 696.
  on Greenland Hare numbers, 686.
  on Greenland Hare range, 685.
  on Greenland Hare rooting method, 690.
  on Greenland Hare sociability, 694.
  on Greenland Hare voice, 695.
  on Greenland Hare weight, 682.
mansuetus, Sylvilagus, 819.
Mantle shifting, Antelope Jack, 774.
Map, Abert Squirrel, 12.
  Antelope Jack, 607.
  Apache Squirrel, 85.
  Arctic Hare, 684.
  Arizona Gray-squirrel, 85.
  Armadillo, 341.

Map (*Continued*)
    Beaver, 446.
    Big Flying-squirrel, 370.
    Blacktailed Jack, 739.
    Brush-rabbit, 607.
    California Gray-squirrel, 12.
    Chipmunk, 186.
    Coney, 639.
    Cottontail, 785.
    Douglas Squirrel, 164.
    Flickertail, 262.
    Forest regions of U. S., 174.
    Fox-squirrel, 85.
    Franklin Ground-squirrel, 252.
    Fremont Squirrel, 164.
    Gopher, 3[illegible].
    Greenland Hare, 684.
    Hoary Marmot, 279.
    Kangaroo-rat, 279.
    Least Chipmunk, 186.
    Little Flying-squirrel, 370.
    Marsh-rabbit, 684.
    Mountain Beaver, 85.
    Muskrat, 560.
    Packrat, 507.
    Porcupine, 607.
    Prairie-dog, 279.
    Pygmy Rabbit, 607.
    Red-squirrel, 164.
    Rockchuck, 341.
    Roundtailed Muskrat, 560.
    Say's Chipmunk, 252.
    Squirrel distribution, 174.
    Snowshoe Rabbit, 739.
    Striped Ground-squirrel, 230.
    Swamp-rabbit, 684.
    Whitetailed Jack, 684.
    Woodchuck, 341.
Ma-qui-hi-ta, *see* Squirrel, Abert.
Marmot, Barking, *see* Prairie-dog.
    Canada, *see* Woodchuck.
    Family, characteristics of, 1.
    Gray, *see* Marmot, Hoary.
    Hoary, contents, 351; life, 352; (ill.), 358; feet (ill.), 362; head (ill.), 362; map, 279.
    Mountain, *see* Marmot, Hoary.
    Prairie, *see* Prairie-dog.
    Whistling, *see* Marmot, Hoary.
    Yellow, *see* Rockchuck.
    Yellow-bellied, *see* Rockchuck.
    Yellow-footed, *see* Rockchuck.
Marmota, genus, characteristics of, 2, 301.
    avara, 339.
    caligata, 352, 353.
    campioni, 339.
    canadensis, 303.
    cascadensis, 353.
    dacota, 339.
    engelhardti, 339.
    flaviventer, 338.
    flaviventris, 338, 339.
    fortirostris, 339.
    ignava, 303.
    luteola, 339.
    monax, 300, 303.
Marmota, genus (*Continued*)
    nivaria, 353.
    nosophora, 339.
    obscura, 339.
    ochracea, 303.
    okanagana, 353.
    olympus, 353.
    oxytona, 353.
    parvula, 339.
    petrensis, 303.
    preblorum, 303.
    rufescens, 303.
    sheldoni, 353.
    sierræ, 339.
    vancouverensis, 353.
    vigilis, 353.
    warreni, 339.
Marmotte du Canada, *see* Woodchuck.
Marsupialia Order, characteristics of, 5.
marsupialis, Didelphis, 868.
Marten, enemy to Big Flying-squirrel, 390.
    enemy to Coney, 644.
    enemy to Red-squirrel, 123.
Marten-box inhabited by Little Flying-squirrel, 372.
martirensis, Lepus, 738.
Maryland, Fox-squirrel in, 84.
Massachusetts, Cottontail in, 784.
    Fox-squirrel in, 84.
    Gray-squirrel numbers in, 25.
    Opossum in, 869.
Mastology, Beaver, 443.
    Chipmunk (ill.), 203.
    Gray-squirrel (ill.), 22.
    Red-squirrel (ill.), 131.
    Woodchuck (ill.), 311, 322.
Mating, Abert Squirrel, 72.
    Antelope Jack, 769.
    Arctic Hare, 675.
    Armadillo, 854.
    Beaver, 473.
    Blacktailed Jack, 740.
    California Gray-squirrel, 63.
    Chipmunk, 192.
    Cottontail, 807.
    Douglas Squirrel, 154.
    Flickertail, 266.
    Fox-squirrel, 94.
    Franklin Ground-squirrel, 254.
    Fremont Squirrel, 165.
    Gray-squirrel, 42.
    Greenland Hare, 691.
    Hoary Marmot, 358.
    Kangaroo-rat, 436.
    Least Chipmunk, 175.
    Little Flying-squirrel, 377.
    Marsh-rabbit, 834.
    Mountain Beaver, 541.
    Muskrat, 597.
    Opossum, 874.
    Packrat, 517.
    Porcupine, 613.
    Rabbit manœuvres (ill.), 750.
    Red-squirrel, 138.
    Snowshoe Rabbit, 717.

Mating (*Continued*)
    Striped Ground-squirrel, 232.
    Swamp Rabbit, 825.
    Whitetailed Jack, 656.
    Woodchuck, 316.
Matteson, F. S.,
    on Mountain Beaver hibernation, 547.
    on Mountain Beaver life history, 529.
    on Mountain Beaver voice, 551.
Maxwell, Mrs. Martha Ann (née Dartt) (1831–1881), Colorado naturalist and her playful Porcupine, 613.
McArthur, O. E., of Blunt, So. Dak., on Prairie-dog numbers in South Dakota, 281.
McChesney, Dr. C. E., U. S. A., of Fort Sisseton, Dak., on Franklin Ground-squirrel nest, 253.
McClintock, Capt. Francis Leopold, Arctic voyage in *Fox*, 1857–59.
    on Greenland Hare numbers on Melville Id., 686.
    on Greenland Hare range, 685.
McCowan, Dan, on Red-squirrel safe amid telegraph wires, 124.
McCown, Capt. J. P., Texas old-timer, on Armadillo haunts, 852.
McCoy, Walter, of Washington, D. C., on Snowshoe Rabbit cannibalism, 717.
    on Snowshoe Rabbit numbers, 708.
    on robes of Snowshoe Rabbit, 727.
McDermott, Dr. C. E., of Leroy, Ohio, on Swamp Rabbit swimming, 825.
M'Dougall, Capt. George Frederick, of Arctic voyage in *Resolute*, 1857.
    on Greenland Hare numbers on Melville Id., 686.
McFadden, William R., Denver taxid., his horned Cottontail, 787.
McGraw, H. A., of Altoona, Pa., on Gray-squirrel numbers, 17.
McGuire, George, Penn. hunter, recent; kills 53 Gray-squirrels on 20 acres, 17.
Meadows, Beaver, 462.
Mearns, Dr. Edgar Alexander (1856–1916), U. S. A., Zool. & Bot.
    on Abert Squirrel as a birdicide, 78.
    on Abert Squirrel food, 77.
    on Abert Squirrel hibernation, 76.
    on Abert Squirrel mating, 72.
    on Abert Squirrel melanos, 68.
    on Abert Squirrel nest, 72.
    on Abert Squirrel numbers, 70.
    on Abert Squirrel origin, 69.
    on Abert Squirrel sociability, 70.
    on Abert Squirrel way of life, 75.
    on Abert Squirrel young, 74.
    on Apache Squirrel food and habits, 109.
    on Apache Squirrel nest and young, 108.
    on Arizona Gray-squirrel food, 113.
    on Arizona Gray-squirrel migration, 112.
    on Arizona Gray-squirrel nest, 114.
    on Arizona Gray-squirrel way of life, 113.
    on Chipmunk food, 198.
    on Cougar *vs.* Beaver, 493.
    on cuterebra in Chipmunk, 198.
Mearns (*Continued*)
    on Fremont Squirrel disposition, 167.
    on Fremont Squirrel food habits, 166.
    on Fremont Squirrel names, 162.
    on Fremont Squirrel soiled pelage, 168.
    on Fremont Squirrel range, 163.
    on Gray-squirrel food, 28.
    on hawk *vs.* Packrat, 510.
    on Opossum in New York, 869.
    on Opossum out in winter, 893.
    on Packrat as food, 508.
    on Packrat home love, 516.
    on Packrat names, 504.
    on snake *vs.* Packrat, 510.
    on Prairie-dog burrow, 284.
    on Prairie-dog names, 276.
mearnsi, Sciurus, 152.
mearnsii, Sylvilagus, 782.
Measham, George Herbert (1864–), journalist, Winnipeg, on Beaver numbers in Manitoba, 450.
    on Chipmunk food, 198.
    on Muskrat and clams, 583.
    on Muskrat home love, 588.
    on Muskrat young, 600.
    on owl attacking Cat, 724.
    on Snowshoe Rabbit years, 706.
Meat, *see* Flesh.
Medsger, Oliver Perry, Prof. Zool. Lincoln High Sch., Arlington, N. J., on Woodchuck climbing, 310.
Meigs, Dr. Charles Delucena (1792–1869), on number of Opossum young, 880.
Melano Abert Squirrel, 68.
    Beaver, 444.
    Gray-squirrel, 10.
    Hoary Marmot, 353.
    Muskrat, 570.
    Opossum, 867.
    Prairie-dog, 277.
    Red-squirrel, 118.
    Rockchuck, 338.
    Snowshoe Rabbit, 701.
    Woodchuck, 302.
melanotis, Lepus, 737.
Memory, Cottontail, 804.
Mendell, Judge George, of Austin, Tex., on Fox-squirrel hunt, 99.
mergens, Ondatra, 570.
Merriam, Dr. Clinton Hart (1855–), Chief U. S. Biol. Surv., achnowledgment to, vi.
    on Big Flying-squirrel breeding, 392.
    on Big Flying-squirrel hibernation, 393.
    on Big Flying-squirrel swimming, 389.
    on Chipmunk caches, 204.
    on Chipmunk habits, 211.
    on Chipmunk migration, 188.
    on Chipmunk up trees, 212.
    on weatherwise Coney, 643.
    on cuterebra, 54.
    on cuterebra in Chipmunk, 198.
    on tails of Geomyidæ, 396.
    on Gray-squirrel adopted by Cat, 47.
    on Gray-squirrel finding buried nuts, 33.
    on Gray-squirrel leaping, 36.

Merriam (*Continued*)
on Gray-squirrel fondness for music, 51.
on Gray-squirrel numbers in New York, 21.
on Gray-squirrel sidling, 49.
on Gray-squirrel storing in winter, 34.
on Gray-squirrel way of life, 48.
on Gray-squirrel young, 44.
on hawk *vs.* Gray-squirrel, 52.
on Little Flying-squirrel gentleness, 381.
on Little Flying-squirrel voice, 373.
on Little Flying-squirrel young, 378.
on Mountain Beaver weight, 527.
on Porcupine eating lily pads, 616.
on Porcupine feeding method, 615.
on Porcupine weight, 604.
on Porcupine young, 615.
on Prairie-dog burrow, 284.
on Prairie-dog mound, 284.
on Prairie-dog numbers, 281.
on Prairie-dog as weather prophet, 287.
on Pygmy Rabbit habits, 842.
on Red-squirrel carrying mushroom, 130
on Red-squirrel swimming, 120.
on Snowshoe Rabbit swimming, 715.
on Woodchuck climbing, 310.
on Woodchuck dens, 305.
on Woodchuck numbers, 304.
on Woodchuck sanitation, 325.
on Woodchuck spring advent, 321.
merriami, Lepus, 737.
Merrill, Major Hamilton Wilcox (1814-1892), U. S. A., of Ft. Belknap, Tex., on Prairie-dog enemies, 295.
on Prairie-dog fearing rattler skin, 295.
on Prairie-dog as weather prophet, 288.
Mershon, William Butts of Saginaw, Mich. (1856-), on Fox-squirrel as birdicide, 92.
on Fox-squirrel tamability, 105.
on Gray-squirrel numbers in Michigan, 23.
Mesed-jee-dah-mo, *see* Ground-squirrel, Franklin.
mexicanus, Castor, 445.
Cynomys, 277.
Dasypus, 850.
Micaceous Schist, a name which, owing to certain sound resemblances, has been erroneously applied to a deposit of murine excretes, (*see* Plate p. 631).
Mice, American, Family, characteristics of, 3.
as food of Franklin Ground-squirrel, 255.
as food of Striped Ground-squirrel, 238.
Michigan, Cottontail in, 784.
Fox-squirrel in, 84.
Gray-squirrel migration in, 17.
Gray-squirrel numbers in, 23.
Gray-squirrel range in, 11.
Opossum in, 869.
michiganensis, Castor, 445.
Migration, Abert Squirrel, 70.
Arizona Gray-squirrel, 112.
causes of, 19.
Chipmunk, 188.
Coney, 640.
definition of, 19.
Fox-squirrel, 84, 98.
Franklin Ground-squirrel, 256.
Migration (*Continued*)
Fremont Squirrel, 165.
Gray-squirrel, 14.
Greenland Hare, 689.
Least Chipmunk, 173.
Muskrat, 574.
Packrat, 506.
Red-squirrel, 120.
Snowshoe Rabbit, 729.
Whitetailed Jack, 653.
Woodchuck, 304.
Migratory Squirrel, *see* Gray-squirrel.
Millais, John Guille (1865-), Br. naturalist, Sussex, Eng.,
on Beaver tolling, 480.
on European Hare life history, 666.
on European Hare mating, 740.
on European Hare migration, 689.
on European Hare young, 741.
Miller, Fred W. (1892-), of Colo. Mus. Nat. Hist., on Rockchuck mother moving young, 343.
Miller, Gerrit Smith, Jr. (1869-), zool. of U. S. Nat. Mus.,
on Least Chipmunk nest, 176.
on Least Chipmunk in Ontario, 172.
on Red-squirrel storing poisonous mushroom, 132.
Miller, John, of La Junta, Colo., on Rabbit slaughter, 758.
Mills, Charles, of Sandusky, O., introduces Fox-squirrel into Ontario, 86.
Mills, Enos Abijah (1870-1922), naturalist of Long's Peak,
on daylight Beavers, 489.
on Beaver digging under ice to roots, 483.
on Beaver family life, 475.
on Beaver food, 483.
on Beaver parasites, 494.
on strength of Beaver lodge, 471.
on Beaver sociability, 478.
on Beaver split toe nail, 494.
on Beaver tree-cutting, 459.
on Grizzly *vs.* Beaver, 493.
on Muskrat *vs.* Beaver, 495.
on owl as enemy to Red-squirrel, 124.
on Porcupine play, 613.
on live Prairie-dog buried by own kind, 296.
on Prairie-dog town, 286.
on Red-squirrel *vs.* Coyote, 124.
on Skunk *vs.* Porcupine, 625.
mimus, Sciurus, 68.
minimus minimus, Eutamias, 170, 171.
Tamias, 170.
Mink, enemy to Cottontail, 797.
and Cottontail live together, 797.
enemy to Gray-squirrel, 52.
enemy to Muskrat, 593.
enemy to Mountain Beaver, 542.
attacks Red-squirrel, 126.
Minnesota, Beaver in, 452.
Cottontail in, 784.
Gray-squirrel migration in, 18.
Muskrat numbers in, 576.
Porcupine numbers in, 608, 609.
Red-squirrel food in, 129.

minnesota, Sciurus, 118.
Miramichi, Camp, Adirondacks, Snowshoe Rabbit young at, 721.
"Miriam," Dr. Powers' Gray-squirrel, 41.
Mishannek, *see* Gray-squirrel.
Mishe-anequs, *see* Gray-squirrel.
Missouri, Fox-squirrel numbers in, 26.
  Gray-squirrel numbers in, 26.
missouriensis, Castor, 445.
Mis-tah-boos, *see* Whitetailed Jack.
Mitchell, J. D., of Victoria, Tex., on Cottontail mother and young, 810.
  on Swamp-rabbit young, 825.
Mittigwab, Chief (George Crawford), on Beaver home range, 448.
Moat, Beaver, 498.
mogollonensis, Sciurus, 162.
Mole, *see* Gopher.
  Giant, *see* Mountain Beaver.
Mole-gopher Family, characteristics of, 2.
mollipilosus, Sciurus, 152.
Molly Cottontail, *see* Cottontail.
Monax, *see* Woodchuck.
monax, Marmota, 300, 303.
  Mus., 300.
Moncrieff, John J., of Winnipeg, on Muskrat young, 600.
Monell, Ambrose, landowner. Sullivan Co., N. Y., introduces Beaver into New York, 451.
Monk, Red, *see* Woodchuck.
Monro, Robert, N. Y. historian of last century on Gray-squirrel numbers in New York, 21.
Montana, Rockchuck numbers in, 342.
monticola, Thomomys, 397.
Montreal *Herald*, on partridge carrying off Red-squirrel, 146.
Moonack, *see* Woodchuck.
Moose bell on Cottontail, 786; (ill.), 805.
Moosehead Lake, Me., gulls eat Red-squirrel at, 125.
Morden, Man., Red-squirrel numbers in, 119.
Morgan, Lewis Henry (1818–1881), of Beaver Monogr.,
  on size of Beaver dams, 465.
  on Beaver bank-dens, 469.
  on Beaver canals, 466, 467; (ill.), 468.
  on Beaver cutting down trees, 459.
  on Beaver cutting up trees, 484.
  on Beaver dams, 460.
  on decay of Beaver dams, 462.
  on Beaver lodge, 470.
  on Beaver numbers, 447.
  on Beaver play, 482.
  on solitary Beavers, 477.
  on Beaver young, 474.
Morris, Dr. Robert Tuttle (1857–), surg. of New York, on cotton overalls and Caribou, 498.
  on Gray-squirrel finding buried nuts, 33.
Morrison, W. W., Calif. trapper, catches 1,738 Muskrats, 575.
Mother, Big Flying-squirrel, 392.
  Hoary Marmot, 358.
Mother love, Cottontail, 812.
  Little Flying-squirrel, 378.
Mother love (*Continued*)
  Muskrat, 600.
  Snowshoe Rabbit, 722.
Motor cars, enemy to Kangaroo-rat, 434.
  enemy to wild animals, 800.
Motten, Dr. Roger Henwood (1879–), of Woodcraft League, on Chipmunk eating grasshopper, 199.
Mould eaten by Red-squirrel, 133.
Mound, Gopher, 414; (ill.), 415.
  Kangaroo-rat, 427.
  Packrat, 513.
  Prairie-dog, 284.
Mound Builder, *see* Packrat.
  Yapper, *see* Prairie-dog.
"Mount Tom" on Cottontail diving into snow, 795.
Mountain Beaver Family, characteristics of, 3.
Mountain Beaver contents, 525; life, 526; (ill.), 534; burrow, (ill.), 546; dead (ill.), 542; map, 85; and whiskers (ill.), 542; teeth, 526.
Mountain Lion, *see* Cougar.
Mouse, Muskrat, *see* Muskrat, Roundtailed.
  Pocket, *see* Gopher.
  Cuterebra in (ill.), 209.
  Mouse-squirrill, *see* Chipmunk.
Moving young, Little Flying-squirrel, 378.
M'possum, *see* Opossum.
Much-woa-pingus, *see* Opossum.
Mud as Porcupine food, 618.
Mud pellets, Gopher, 407.
  pies, Beaver, 480.
Mudcat, *see* Muskrat.
Muir, John, The Sage of the Sierras (1838–1917),
  on Douglas Squirrel food, 156.
  on Douglas Squirrel haunts, 153.
  on Douglas Squirrel voice, 155.
  on Douglas Squirrel way of life, 156.
  on Mountain Beaver life history, 529.
  on Mountain Beaver water control, 536.
Mule, Narrow-gauge, see Blacktailed Jack.
Murdoch, John (1852–1925), zool. & ethno. of Pt. Barrow Exped., 1881–1883.
  on Arctic Hare numbers, 671.
Murie, Olaus Johan (1889–), of U. S. Biol. Surv., acknowledgement to, vi.
  on fighting Muskrat, 596.
  on Porcupine eating mud, 618.
  on Porcupine use of tail, 621.
  on Porcupine voice, 612.
  on Red-squirrel weight, 117.
Murphy, J. M., on Mountain Beaver life history, 529.
Mus cinereus, 504.
  monax, 300.
  volans, 368.
Museum, American, acknowledgment to, x.
  Canadian Geological Survey, Gray-squirrel in, 11.
  Denver, has horned Cottontail, 787.
  Fairbanks, albino Woodchuck at, 302.
  National, acknowledgment to, v, x.
Museum, Packrat, 520.
Mushrat, *see* Muskrat.

Mushrooms as Packrat food, 518.
as Red-squirrel food, 130.
see also Fungi.
Music fascinates Gray-squirrel, 51.
Musk, Mountain Beaver, 527.
see also Glands.
Muskallonge eats Red-squirrel, 125.
Musk-bags, Beaver, 482.
Muskrat, contents, 567; life, 569; den (ill.), 573, 579; dung (ill.), 589; feet (ill.), 573; house (ill.), 589; map, 560; tail (ill.), 573; teeth, 569; track (ill.), 595.
enemy to Beaver, 490.
Allen's, *see* Muskrat, Roundtailed.
Blue, *see* Mountain Beaver.
Roundtailed, contents, 557; life, 558; map, 560.
Musquash, *see* Muskrat.

N., W. B., on fear in Blacktailed Jack, 747.
Names, Abert Squirrel, 68.
Antelope Jack, 764.
Apache Squirrel, 108.
Arctic Hare, 668.
Arizona Gray-squirrel, 112.
Armadillo, 848.
Beaver, 443.
Big Flying-squirrel, 386.
Blacktailed Jack, 736.
Brush-rabbit, 818.
California Gray-squirrel, 60.
Chipmunk, 184.
Coney, 636.
Cottontail, 781.
Douglas Squirrel, 152.
Flickertail, 260.
Franklin Ground-squirrel, 250.
Fremont Squirrel, 162.
Gopher, 396.
Gray-squirrel, 9.
Greenland Hare, 682.
Hoary Marmot, 352.
Least Chipmunk, 170.
Little Flying-squirrel, 368.
Marsh-rabbit, 830.
Mountain Beaver, 526.
Muskrat, 569
Opossum, [illegible].
Packrat, 504.
Porcupine, 604.
Prairie-dog, 276.
Pygmy Rabbit, 840.
Red-squirrel, 117.
Rockchuck, 338.
Roundtailed Muskrat, 558.
Say's Chipmunk, 218.
Snowshoe Rabbit, 700.
Striped Ground-squirrel, 228.
Swamp-rabbit, 822.
Whitetailed Jack, 648.
Woodchuck, 300.
Nanabojou and Muskrat, 574.
Nash, Charles William (1848–1926), naturalist to Province of Ontario, 1903–1926.
on first Cottontail near Niagara, 784.
Nash (*Continued*)
on Snowshoe Rabbit young, 720.
on Whitetailed Jack range, 651.
on Whitetailed Jack weight, 649.
National Forests, Beaver in, 453.
Nead, H. G., taxid., Dauphin, Man., on Striped Ground-squirrel range, 231.
nebulosus, Thomomys talpoides, 398.
neglectus, Eutamias minimus, 172.
Sciurus, 83.
Nelson, Dr. Edward William (1855–), zool., ethno., chief U. S. Biol. Surv., acknowledgment to, vi.
on Abert Squirrel food, 78.
on Abert Squirrel freezing, 71.
on Abert Squirrel home life, 74.
on Abert Squirrel leaping, 71.
on Abert Squirrel numbers, 70.
on Abert Squirrel tail, 71.
on Abert Squirrel voice, 72.
on Antelope Jack coloration, 774.
on Antelope Jack forms, 769.
on Antelope Jack home range, 768.
on Antelope Jack mating, 769.
on Antelope Jack numbers, 768.
on Antelope Jack spy-hop, 773.
on Arctic Hare nocturnalism, 674.
on Arctic Hare numbers, 671.
on snaring Arctic Hare, 678.
on Arctic Hare solitariness, 675.
on Arctic Hare swimming, 674.
on Arctic Hare tamability, 677.
on Armadillo food, 856.
on Armadillo haunts, 852.
on Armadillo myth, 862.
on Armadillo, Cottontail, and rattler living together, 860.
on Armadillo when alarmed, 858.
on Armadillo young, 854.
on Big Flying-squirrel numbers, 389.
on Cottontail in Maine, 784.
on Cottontail mother and young, 810.
on Coyotes *vs.* Armadillo, 858.
on Greenland Hare anatomy, 683.
on Hoary Marmot fur, 354.
on Kangaroo-rat play, 434.
on Least Chipmunk character, 179.
on Least Chipmunk food, 176.
on Least Chipmunk haunts, 173.
on Least Chipmunk young, 175.
on Little Flying-squirrel voice, 373.
on Mountain Beaver colonies, 531.
on Mountain Beaver food, 537.
on Mountain Beaver haymaking, 539.
on Mountain Beaver hibernation, 548.
on Mountain Beaver sanitation, 540.
on Mountain Beaver voice, 551.
on Mountain Beaver way of life, 548.
on Opossum feigning death, 885.
on Packrat drumming, 512.
on Packrat as food, 508.
on Packrat stealing shoes, 520.
on Packrat storage, 519.
on Prairie-dog numbers in Arizona, 281.
on Red-squirrel in winter, 148.

Nelson, Seth, Jr., hunter, of Round Id., Clinton Co., Pa., on Chipmunk mating, 193.
Neofiber, genus, characteristics of, 3, 558.
  alleni, 558.
  nigrescens, 558.
neomexicanus, Sciurus, 162.
Neotoma genus, characteristics of, 3, 504.
  arizonæ, 505.
  cinerea, 504, 505.
  drummondii, 505.
  fusca, 505.
  lucida, 505.
  occidentalis, 505.
  orolestes, 505.
  rupicola, 505.
  saxamans, 505.
Nerve bristles, Red-squirrel (ill.), 131.
Nerves of Cottontail, 795.
"Nessmuk," *see* Sears, George W.
Nest, Abert Squirrel, 72; (ill.), 79.
  Apache Squirrel, 108.
  Arctic Hare, 677.
  Arizona Gray-squirrel, 114.
  Beaver, 474.
  Big Flying-squirrel, 392.
  Blacktailed Jack, 741.
  California Gray-squirrel, 62.
  Chipmunk, 191.
  Coney, 646.
  Cottontail, 808, 809.
  Crow, compared with Gray-squirrel, 43.
  Douglas Squirrel, 153.
  Flickertail, 266.
  Fox-squirrel, 93.
  Fremont Squirrel, 165.
  Gopher, 401, 407; (ill.), 409.
  Gray-squirrel, 43; (ill.), 39.
  Hawk, compared with Gray-squirrel, 43.
  Kangaroo-rat, 429.
  Least Chipmunk, 176.
  Little Flying-squirrel, 375.
  Marsh-rabbit, 834.
  Mountain Beaver, 541.
  Muskrat, 590.
  Opossum, 873.
  Packrat, 513; (ill.), 514.
  Porcupine, 613.
  Red-squirrel, 136; (ill.), 145.
  Red-squirrel, examined for parasites, 127.
  Rockchuck, 343; (ill.), 346.
  Roundtailed Muskrat, 562.
  Snowshoe Rabbit, 718.
  Striped Ground-squirrel, 233, 234.
  Swamp-rabbit, 825.
  Whitetailed Jack, 656.
  Woodchuck, 308.
nevadensis, Ochotona, 637.
New Brunswick, Gray-squirrel in, 11.
New England, Cottontail in, 784.
Newfoundland, Beaver numbers in, 450.
New Hampshire, Beaver numbers in, 451.
  Cottontail in, 784.
  Opossum in, 869.
  Porcupine numbers in, 608.
New Jersey, Beaver numbers in, 451.
  Fox-squirrel in, 84.
  Whitetailed Jack in, 652.
New York, Beaver numbers in, 451.
  Cottontail in, 784.
  Cottontail numbers in, 801, 803.
  Fox-squirrel in, 84.
  Gray-squirrel migration in, 16, 17.
  Gray-squirrel numbers in, 21, 26.
  Muskrat numbers in, 576.
  Opossum in, 869.
New York Zoological Society, acknowledgment to, v.
Nicaragua, Armadillo numbers in, 852.
Nichols, Ross, bird photog., Portland, Ore., on ptarmigan coloration, 703.
Nicholson, Donald, taxid. Morden, Man., on Chipmunk in Manitoba, 185.
niger, Sciurus, 82, 83.
nigra, Aplodontia, 528.
nigrescens, Neofiber, 558.
  Ochotona, 637.
nigripes, Sciurus, 60.
nivaria, Marmota, 353.
Nocturnal, Arctic Hare, 674.
  Armadillo, 853.
  Chipmunk, 188.
  Gopher, 404.
  Gray-squirrel, 49.
  Greenland Hare, 696.
  Kangaroo-rat, 424.
  Little Flying-squirrel, 373.
  Mountain Beaver, 537, 545.
  Opossum, 885, 894.
  Porcupine, 610.
  Pygmy Rabbit, 842, 844.
  Red-squirrel, 142.
  Snowshoe Rabbit, 730.
  Whitetailed Jack, 653.
  Woodchuck, 331.
North Carolina, Cottontail numbers in, 802.
North Dakota, *see* Dakota, North.
Northern Pocket-gopher, *see* Gopher.
nosophora, Marmota, 339.
Nova Scotia, Gray-squirrel in, 13.
novemcinctus, Dasypus, 848, 850.
Nulato, Alaska, melano Red-squirrel at, 118.
Numbers, Abert Squirrel, 70.
  Antelope Jack, 768.
  Arctic Hare, 671.
  Armadillo, 852.
  Beaver, 447, 448.
  Big Flying-squirrel, 388.
  Blacktailed Jack, 754.
  Chipmunk, 189.
  Coney, 638.
  Cottontail, 801.
  Douglas Squirrel, 153.
  European Hare, 666.
  Flickertail, 261.
  Fox-squirrel, 86.
  Franklin Ground-squirrel, 251.
  Fremont Squirrel, 163.
  Gopher, 400.
  Gray-squirrel, ancient, 21.

Numbers (*Continued*)
    Gray-squirrel in migration, 18.
    Gray-squirrel present, 26.
    Greenland Hare, 685.
    Hoary Marmot, 354.
    Kangaroo-rat, 422.
    Least Chipmunk, 17[illegible]
    Little Flying-squirrel, 369.
    Marsh-rabbit, 832.
    Mountain Beaver, 531.
    Muskrat, 575.
    Opossum, 871.
    Packrat, 506.
    Porcupine, 606.
    Prairie-dog, 280.
    Rabbit ebb and flow, 711.
    Red-squirrel, 119.
    Rockchuck, 340.
    Roundtailed Muskrat, 561.
    Snowshoe Rabbit, 705.
    Striped Ground-squirrel, 231.
    Swamp-rabbit, 824.
    Whitetailed Jack, 653.
    Woodchuck, 304.
Nursing of Flying-squirrel, 393.

OATS as Hoary Marmot food, 355.
Oberholser, Harry Church (1870–), ornith. U. S. Biol. Surv.,
    on damage by Blacktailed Jack, 748.
obscura, Marmota, 339.
    Ondatra, 571.
occidentalis, Neotoma, 505.
occipitalis, Ondatra, 570.
Ochotona genus, characteristics of, 4, 636.
    brooksi, 638.
    brunnescens, 638.
    collaris, 637.
    cuppes, 638.
    fenisex, 638.
    figginsi, 637.
    fumosa, 638.
    incana, 638.
    lemhi, 637.
    levis, 637.
    lutescens, 637.
    nevadensis, 637.
    nigrescens, 638.
    princeps, 636, 637.
    saxatilis, 637.
    schisticeps, 637.
    uinta, 637.
    ventorum, 637.
Ochotonidæ Family, characteristics of, 4, 636.
ochracea, Marmota, 303.
ocius, Thomomys talpoides, 398.
Œstrus, parasite of Cottontail, 800.
Oga, *see* Porcupine.
O-gwool-lal, *see* Mountain Beaver.
Ohio, Gray-squirrel migration in, 16, 18.
    Gray-squirrel numbers in, 21.
Ohnimus, Louis J., Supt. Woodward Zoo, San Francisco,
    on Gopher breeding, 401.
    on Gopher numbers in Golden Gate Park, San Francisco, 400.
Oil-stones, Beaver, 481.
okanagana, Marmota, 353.
Olds, Fred A., of Raleigh, N. C., on Cottontail numbers in North Carolina, 802.
olivaceus, Citellus, 229.
olympica, Aplodontia, 528.
olympicus, Glaucomys, 387.
    Marmota, 353.
Ondatra genus, characteristics of, 3, 569.
    alba, 570.
    aquilonia, 570.
    cinnamomina, 570.
    macrodon, 570.
    mergens, 570.
    obscura, 571.
    occipitalis, 570.
    osoyoosensis, 570.
    pallida, 570.
    ripensis, 570.
    rivalicia, 571.
    spatulata, 570.
    zalopha, 570.
    zibethica, 569, 570.
Ontario, Beaver numbers in, 450.
    Chipmunk in, 185.
    Cottontail in, 784.
    Gray-squirrel in, 11.
    Least Chipmunk in, 172.
    Porcupine numbers in, 606.
    Red-squirrel in, 122.
Oo-ka-lik, *see* Arctic Hare.
Ootaw-chee-gaeshees, *see* Gopher.
operarius, Eutamias minimus, 171.
Opassum, *see* Opossum.
Opossum, contents, 865; life, 866; feet (ill.), 886; poses (ill.), 878; up a tree (ill.), 870; skull (ill.), 883; tail carrying bedding (ill.), 883; teeth, 866; tracks (ill.), 883, 886.
    Family, characteristics of, 5.
    enemy to Gray-squirrel, 52.
Order Anteaters, characteristics of, 5.
    Armadillos, 5.
    Edentata, 5.
    Lagomorpha, 4.
    Marsupialia, 5.
    Rabbits, 4.
    Rodentia, 1.
    Sloths, 5.
    Xenarthra, 5.
Oregon, Beaver in, 452.
oregonensis, Glaucomys, 387.
oreocetes, Eutamias minimus, 172.
orizabae, Sylvilagus, 783.
orolestes, Neotoma, 505.
Osborn, S. E., on Rockchuck hibernation, 348.
Osgood, Dr. Wilfred Hudson (1875–), Zool. curator, Field Mus.
    on Hoary Marmot burrows, 356.
    on Mountain Beaver solitariness, 541.
    on Prairie-dog home, 286.
    on Red-squirrel nests in Alaska, 137.
    on Red-squirrel workshop, 128.

osoyoosensis, Ondatra, 570.
Ossa, or Opossum, 868.
othus, Lepus, 670.
Ottawa, Dept. of Interior, acknowledgment to, v.
Otter, enemy to Beaver, 491.
    enemy to Muskrat, 593.
Ou-ka-la, *see* Mountain Beaver.
Outcast Beaver, 476.
Oves, C. M., Pennsylvania sportsman, on Snowshoe Rabbit cold sleep, 730.
    on Snowshoe Rabbit weight, 700.
Owl, enemy to Arctic Hare, 673.
    enemy to Big Flying-squirrel, 390.
    enemy to Blacktailed Jack, 751.
    enemy to Cottontail, 799.
    enemy to Flickertail, 271.
    enemy to Franklin Ground-squirrel, 257.
    enemy to Gopher, 405.
    enemy to Gray-squirrel, 52.
    enemy to Greenland Hare, 695.
    enemy to Kangaroo-rat, 434.
    enemy to Mountain Beaver, 542.
    enemy to Muskrat, 592.
    enemy to Opossum, 893.
    enemy to Packrat, 510.
    enemy to Red-squirrel, 124.
    enemy to Snowshoe Rabbit, 724.
    full of Porcupine quills, 623.
    living with Prairie-dog and rattler, 292.
    living with Red-squirrel, 146.
    and dead Rabbit (ill.), 726.
Owning, Fox-squirrel nuts, 91.
oxytona, Marmota, 353.

P., R. F., on Red-squirrel mother and young, 141.
    pacifica, Aplodontia, 528.
Packrat, contents, 503; life, 504; (ill.), 510; dung (ill.), 514; ear (ill.), 509; feet (ill.), 509; map, 507; nest, (ill.), 514; skull (ill.), 509; tail (ill.), 509; teeth, 504; (ill.), 509.
    Florida (ill.), 510.
    Rocky Mountain (ill.), 422.
Pah-hee, *see* Porcupine.
Pah-hin, *see* Porcupine.
Pairing, *see* Mating.
palitans, Lepus, 765.
pallida, Ondatra, 570.
pallidus, Citellus, 229.
    Eutamias minimus, 171.
Palmer, Dr. Theodore Sherman (1868–   ), zool. U. S. Biol. Surv., acknowledgment to, vii.
    on Beaver numbers in Algonquin Park, 447.
    on Blacktailed Jack enemies, 751.
    on Blacktailed Jack numbers, 757.
    on Cottontail numbers in Virginia, 803.
    on Rabbit drives, 758.
    on Rabbit parasites, 752.
    on Whitetailed Jack parasites, 663.
    on Woodchuck names, 301.
Palmer, William (1856–1927), zool. U. S. Nat. Mus., on Fox-squirrel in Washington, D. C., and Maryland, 84.
paludicola, Sylvilagus, 831.
palustris, Lepus, 830.
    Sylvilagus, 830, 831.
Panniculus, Antelope Jack, 766.
Panther, *see* Cougar.
Parasites, 592.
    on Antelope Jack, 772.
    of Beaver, 493.
    of Blacktailed Jack, 752.
    of Flickertail, 271.
    of Gopher, 407.
    of Gray-squirrel, 53.
    of Marsh-rabbit, 833.
    of Muskrat, 592.
    of Red-squirrel, 126.
    of Rockchuck, 344.
    of Roundtailed Muskrat, 564.
    of Snowshoe Rabbit, 725.
    of Striped Ground-squirrel, 242.
    of Whitetailed Jack, 663.
    Red-squirrel on sapsucker, 132.
Parks, Harold Ernest (1880–   ), of Berkeley, Calif., on Packrat collection, 521.
    on Packrat eating fungi, 518.
    on Packrat home love, 516.
    on combustibility of Packrat nests, 515.
    on snake *vs.* Packrat, 510.
    on Packrat sociability, 511.
    on Packrat storage, 520.
    on Packrat trading, 522.
    on Packrat in trees, 513.
Parry, Capt. William Edward (1790–1855), Arctic Exped., 1819, 1821, and 1824,
    on Greenland Hare food, 689.
    on Greenland Hare numbers on Melville Id., 686.
Partridge carries off Red-squirrel, 146.
parvidens, Cynomys, 277.
parvula, Marmota, 339.
parvus, Citellus, 229.
Pattie, James Ohio (1804–   ), Arizona explorer, on Beaver numbers, 448.
Paws, *see* Feet.
Payne, Charles, ranchman, Wichita, Kas., on Blacktailed Jack numbers, 757.
Pearce, Lionel, of Stonebridge, Eng., on Dog and ghost Rabbit, 796.
Peary, Commander Robert Edwin (1854–1920), U. S. N., Arctic Explor.
    on Greenland Hare range, 685.
Peba, *see* Armadillo.
Pebbles stored by Chipmunk, 206.
Peet, Dr. Max M., of Ypsilanti, Mich., on Least Chipmunk voice, 181.
Pee-to-wab-oos-ongs, or dermoid cysts, 728.
Pekan, *see* Fisher.
Pellett, Frank Chapman (1879–   ), of Atlantic, Iowa, on Cottontail defence, 791.
    on Cottontail fights, 806.
    on Cottontail mother devotion, 812.
    on Cottontail numbers in Iowa, 802.
Pelt, Woodchuck, 312.
    see also Fur.
peninsularis, Sylvilagus, 819.
Penis, Arctic Hare, 669.
    Armadillo (ill.), 859.
Pennsylvania, Beaver numbers in, 451.
    Cottontail numbers in, 803.

- Pennsylvania (*Continued*)
  - Fox-squirrel in, 84.
  - Gray-squirrel numbers in, 21, 26.
  - Gray-squirrel migration in, 16, 17, 18.
  - Gray-squirrel weight in, 10.
- Perkins, Prof. George Henry (1844–), Geol., Anthrop., Univ., Vermont, on Little Flying-squirrel playfulness, 382.
- Perognathus, range of, 421.
- perpallidus, Callospermophilus, 219.
  - Thomomys, 397.
- Perry, Walter, S., of Bend, Ore., on Douglas Squirrel nest, 154.
- petrensis, Marmota, 303.
- petulans, Sciurus, 119.
- Phacelia (water-leaf) as Kangaroo-rat food, 426.
- phæa, Aplodontia, 528.
- phæonotus, Lepus, 701.
- phæurus, Sciurus, 69.
- phæus, Castor, 445.
- Phillips, Dr. John Charles (1876–), zoologist, of Wenham, Mass., on Woodchuck swimming, 312.
- picatus, Sciurus, 119.
- picinum, Erethizon, 605.
- Pickerel captures Gray-squirrel, 53.
  - enemy to Red-squirrel, 125.
- Picket-pin, *see* Flickertail.
- pictus, Eutamias minimus, 171.
- Piers, Harry (1870–), zool. Provincial Mus., Halifax, N. S., on Gray-squirrel in Nova Scotia, 13.
- Pierson, E. E., of Bloomingdale, Ill., on Cottontail numbers in Illinois, 802.
- Pig, Whistling, *see* Marmot, Hoary.
- pigra, Didelphis, 867.
- Pika Family, characteristics of, 4.
- Pika, *see* Coney.
- Pike captures Gray-squirrel, 53.
- Pike, Warburton, (1861–1915) of Barrenground fame, on Snowshoe Rabbit year, 706.
- Pine-squirrel, Abert's, *see* Squirrel, Abert's.
- Piney Sprite, *see* Squirrel, Douglas.
  - Yellow, *see* Squirrel, Douglas
- Ping-sping-sa, *see* Prairie-dog.
- Pitblado, Isaac, K. C., lawyer of Winnipeg, on Muskrat young, 600.
- Plague, Rabbit, 709.
- Plant, Gopher food (ill.), 411.
- Play, Beaver, 482.
  - Blacktailed Jack, 744.
  - Greenland Hare, 695.
  - Kangaroo-rat, 434.
  - Little Flying-squirrel, 382.
  - Muskrat, 581.
  - Opossum, 885.
  - Porcupine, 613.
  - Woodchuck, 319, 326.
- Playground, Beaver, 482.
  - Red-squirrel (ill.), 157.
  - Striped Ground-squirrel (ill.), 245.
- Plough, enemy to Striped Ground-squirrel, 244.
- poadromus, Lepus, 670.
- Pocket-gopher, *see* Gopher.
- Pocket Jumping-mice, Family, characteristics of, 2.
- Poh-kahn, *see* Flying-squirrel, Big.
- Poison warfare on Rabbits, 758.
- Polatouche, *see* Flying-squirrel, Big.
  - *see also* Flying-squirrel, Little.
- Ponds, Yancey Beaver (ill.), 464.
- Pontoon, *see* Rabbit, Marsh.
- Poole, Earl Lincoln, of Reading, Pa., on Packrat collection, 521.
- Pope, Dr. Alton S., of Chicago, Ill., on Red-squirrel swimming, 120.
- Porc-épic vélu, *see* Porcupine.
- Porcupine, Canada, or Porcupine; contents, 603; life, 604; and Lynx, (ill.), 626; at home (ill.), 614; map, 607; poses (ill.), 619, 622; quill (ill.), 619; teeth, 604.
  - Family, characteristics of, 4.
  - Gray, *see* Porcupine, Canada.
  - Yellow-haired, 605.
- Porkespicke, *see* Porcupine.
- Porky-hog, *see* Porcupine.
- Portulaca as source of drink to Kangaroo-rat, 427.
- Porty-pine, *see* Porcupine.
- Poses, Antelope Jack (ill.), 777.
  - Beaver (ill.), 470, 486.
  - Chipmunk (ill.), 198, 203.
  - Coneys (ill.), 645.
  - Cottontail (ill.), 790.
  - Flying-squirrels (ill), 376.
  - Gopher (ill.), 403.
  - Gray-squirrel (ill.), 54.
  - Opossum (ill.), 878.
  - Porcupine (ill.), 619, 622.
  - Prairie-dog (ill.), 278.
  - Snowshoe Rabbit (ill.), 714, 731.
  - Whitetailed Jack (ill.), 655, 662.
- Possum, *see* Opossum.
- Posts, Rubbing, Cottontail, 789.
- Po-tach-i-ping-gu-a-shi, *see* Gopher.
- Potatoes stolen by Red-squirrel, 133.
- Potter, Lawrence B., of Eastend, Sask., on Prairie-dog in Saskatchewan, 278.
- Pouches, Chipmunk, 202.
  - Flickertail, 270.
  - Kangaroo-rat (ill.), 432.
  - Striped Ground-squirrel, 241.
- Powers, Dr. Lillian Delger, of White Plains, N. Y., acknowledgment to, v, vi.
  - on Gray-squirrel age, 56.
  - on Gray-squirrel blind period, 44.
  - on Gray-squirrel gestation, 44.
  - on Gray-squirrel mating, 42.
  - on Gray-squirrel sanitary nests, 45.
  - on Gray-squirrel storage, 34.
  - on Gray-squirrel voice, 40.
  - on Little Flying-squirrel mating, 378.
- Prairie-dog, contents, 275; life, 276; burrow (ill.), 285; map, 279; poses (ill.), 278; skull (ill.), 293.
  - Blacktailed, *see* Prairie-dog.
  - Louisiana, *see* Prairie-dog,
  - Short-tailed, 277.
  - Whitetailed, 277.
- Prairie-squirrel, Yellow, *see* Flickertail.
- Pray, Leon Luther (1882), of Field Museum, on Little Flying-squirrel eating beetles, 374.

Pray (*Continued*)
on Opossum eating live young, 890.
on Opossum use of tail, 873.
Preble, Edward Alexander (1871–), ornith., mammalog., U. S. Biol. Surv., acknowledgment to, v.
on Hoary Marmot hibernation, 363.
on Least Chipmunk food, 176.
on Least Chipmunk at Keewatin, 172.
on Least Chipmunk out in snow, 180.
on robes of Snowshoe Rabbit, 727.
on Woodchuck names, 301.
preblorum, Marmota, 303.
Prevost, trapper, quoted by Bachman, on Beaver game, 482.
on lazy Beaver, 476.
Price, W. W., on Mountain Beaver voice, 551.
Prickle-cub, *see* Porcupine.
princeps, Lagomys, 636.
Lepus, 636.
Ochotona, 636, 637.
Proger, Thomas W., Welsh naturalist, on European Hare home range, 653.
Prospect holes, Kangaroo-rat, 426.
"Prowler," *see* Risteen, Frank H.
pryori, Thomomys talpoides, 398.
Psin-cha, *see* Flying-squirrel, Big.
Puck-o'-the-Pines, *see* Red-squirrel.
Purchas, Samuel (1577–1626), English clergyman-author, noted chiefly for his "Pilgrimage,"
on Armadillo, 850.
on Little Flying-squirrel names, 368.
on Opossum, 868.
on Porcupine names, 604.
pygmæus, Thomomys talpoides, 398.

QUADRIVITTATUS, Eutamias, 170.
Quebec, Beaver numbers in, 450.
Gray-squirrel in, 11.
querceti, Glaucomys, 369.
Quill, Porcupine, 618; (ill.), 619.
Quill embroidery of Indians, 629.
Quiller, *see* Porcupine.
Quill-pig, *see* Porcupine.
Quis-qui-su, *see* Marmot, Hoary.

RABBIT, blind period, 44.
eaten by Franklin Ground-squirrel, 256.
enemy to Mountain Beaver, 542.
gestation of, 44, 266.
mating manœuvres (ill.), 750.
years, 705.
Bachman's, *see* Rabbit, Brush.
Brush, of California, *see* Rabbit, Brush.
Brush, contents, 817; life, 818; map, 607.
Burrowing, *see* Rabbit, Pygmy.
Cottontail, *see* Cottontail.
Family, characteristics of, 4.
Gray, *see* Cottontail.
Jackass, *see* Antelope Jack.
Lesser Marsh, *see* Rabbit Marsh.
Marsh, contents, 829; life, 830; map, 684.
Order, characteristics of, 4.
Rabbit (*Continued*)
Pontoon, *see* Rabbit, Marsh
Pygmy, contents, 839; life, 840; (ill.), 842; map, 607.
Pygmy of Idaho, *see* Rabbit, Pygmy.
Rock, *see* Coney.
Short, *see* Rabbit, Pygmy.
Small Water, *see* Rabbit, Marsh.
Snowshoe, *see* Snowshoe Rabbit.
Squeak, *see* Coney.
Swamp, contents, 821; life, 822; map, 684.
Water, *see* Rabbit, Marsh.
Wet, *see* Rabbit, Marsh.
White, *see* Snowshoe Rabbit.
White Wool, *see* Hare, Greenland.
Wood, *see* Cottontail.
Raccoon, enemy to Gray-squirrel, 52.
enemy to Mountain Beaver, 542.
killed by Porcupine quills, 622.
skull (ill.), 883.
Races, Abert Squirrel, 69.
Arctic Hare, 670.
Arizona Gray-squirrel, 112.
Armadillo, 850.
Beaver, 444.
Big Flying-squirrel, 387.
Blacktailed Jack, 737.
Brush-rabbit, 818.
California Gray-squirrel, 60.
Chipmunk, 185.
Coney, 637.
Cottontail, 782.
Douglas Squirrel, 152.
Fox-squirrel, 83.
Fremont Squirrel, 162.
Gopher, 397.
Gray-squirrel, 10.
Hoary Marmot, 353.
Kangaroo-rat, 421.
Least Chipmunk, 171.
Little Flying-squirrel, 369.
Marsh-rabbit, 831.
Mountain Beaver, 527.
Muskrat, 570.
Opossum, 867.
Packrat, 505.
Porcupine, 605.
Prairie-dog, 277.
Red-squirrel, 118.
Rockchuck, 339.
Roundtailed Muskrat, 558.
Say's Chipmunk, 219.
Snowshoe Rabbit, 701.
Striped Ground-squirrel, 229.
Swamp-rabbit, 823.
Whitetailed Jack, 650.
Woodchuck, 303.
Radford, Harry Vincent (1881–1912), on Beaver bedding, 474.
introduces Beaver in Adirondacks, 451.
on primitive Beaver numbers, 447.
Rae, Dr. John (1813–1893), accompanied Richardson's Franklin Search. Exped., 1849–50, on Muskrat eating huts, 590.

Rafinesque-Smaltz, Constantine Samuel (1784–1842), French-American bot. and zool.
  names Mountain Beaver, 529.
Raft, Muskrat, 590.
rainieri, Aplodontia, 528.
Range, Abert Squirrel, 69.
  Antelope Jack, 767.
  Apache Squirrel, 108.
  Arctic Hare, 670.
  Arizona Gray-squirrel, 112.
  Armadillo, 850.
  Beaver, 445.
  Big Flying-squirrel, 388.
  Blacktailed Jack, 738.
  Brush-rabbit, 819.
  California Gray-squirrel, 61.
  Chipmunk, 185.
  Coney, 638.
  Cottontail, 784.
  Douglas Squirrel, 153.
  European Hare, 665.
  Flickertail, 261.
  Fox-squirrel, 84.
  Franklin Ground-squirrel, 25.
  Fremont Squirrel, 163.
  Geomyidæ, 398.
  Gopher, 398.
  Gray-squirrel, 11.
  Greenland Hare, 683.
  Hoary Marmot, 354.
  Kangaroo-rat, 421.
  Least Chipmunk, 172.
  Little Flying-squirrel, 369.
  Marsh-rabbit, 831.
  Mountain Beaver, 529.
  Muskrat, 571.
  Opossum, 868.
  Packrat, 506.
  Porcupine, 605.
  Prairie-dog, 278.
  Pygmy Rabbit, 841.
  Red-squirrel, 121.
  Rockchuck, 340.
  Roundtailed Muskrat, 559.
  Say's Chipmunk, 220.
  Snowshoe Rabbit, 704.
  Striped Ground-squirrel, 229.
  Swamp-rabbit, 823.
  Whitetailed Jack, 650.
  Woodchuck, 303.
Rasmussen, Captain Knud (Johan Victor) (1879–   ), Polar explorer,
  on Greenland Hare numbers, 686, 687.
  on Greenland Hare range, 685.
Rat, Bush, *see* Packrat.
  Bushy-tailed, *see* Packrat.
  Cave, *see* Packrat.
  Crib, *see* Muskrat, Roundtailed.
  Desert, *see* Kangaroo-rat.
  Drummer, *see* Packrat.
  Dusky-footed Wood, 504.
  File-tailed, *see* Muskrat, Roundtailed.
  Florida (ill.), 510.
  Four-toed, *see* Kangaroo-rat.
Rat, Bush (*Continued*)
  Kangaroo, *see* Kangaroo-rat.
  Mountain, *see* Packrat.
  Musqué, *see* Muskrat.
  of the Desert, *see* Kangaroo-rat.
  Pack, *see* Packrat.
  Prairie, *see* Muskrat, Roundtailed.
  Roundtailed Wood, 504.
  Sand, *see* Gopher.
  Slide, *see* Coney.
  Starved, *see* Coney.
  Trade, *see* Packrat.
  Water, *see* Muskrat, Roundtailed.
  Wood, *see* Packrat.
  Yap, *see* Prairie-dog.
Rat, gestation of, 266.
Rattler, enemy to Kangaroo-rat, 434.
  enemy to Opossum, 893.
  living with Prairie-dog and owl, 292.
Raven, enemy to Arctic Hare, 673.
  enemy to Greenland Hare, 695.
Red-fox, enemy to Gray-squirrel, 52.
Red Monk, *see* Woodchuck.
Red Robber, *see* Red-squirrel.
Red-squirrel, contents, 115; life, 117; (ill.) 126; feet (ill.), 131; map, 164; mastology (ill.), 131; nest (ill.), 145; playground (ill.), 157; poses (ill.), 145; storing mushrooms (ill.), 142; tracks (ill.), 131; skull (ill.), 432; compared with Gray-squirrel, 9; enemy to Chipmunk, 197; enemy to Gray-squirrel, 52; enemy to Mountain Beaver, 542.
  Big, *see* Fox-squirrel.
  Fremont's, *see* Squirrel, Fremont's.
  Western, *see* Squirrel, Douglas.
Reeks, Henry, F. L. S. (1838–1882), English naturalist, studied birds and flowers in Newfoundland, 1866.
  on Arctic Hare haunts, 671.
Reeves, Fred C., Adirondack guide, sees Red-squirrel mother and young near Kippewa, 142.
References, Abert Squirrel, 79.
  Antelope Jack, 778.
  Arctic Hare, 679.
  Armadillo, 863.
  Beaver, 500.
  Big Flying-squirrel, 394.
  Blacktailed Jack, 761.
  Brush-rabbit, 820.
  California Gray-squirrel, 66.
  Chipmunk, 215.
  Coney, 646.
  Cottontail, 815.
  Douglas Squirrel, 159.
  Fox-squirrel, 106.
  Franklin Ground-squirrel, 257.
  Fremont Squirrel, 168.
  Gray-squirrel, 59.
  Greenland Hare, 697.
  Hoary Marmot, 364.
  Kangaroo-rat, 440.
  Least Chipmunk, 181.
  Little Flying-squirrel, 384.

References (*Continued*)
  Marsh-rabbit, 837.
  Mountain Beaver, 554.
  Muskrat, 601.
  Opossum, 896.
  Packrat, 523.
  Porcupine, 633.
  Prairie-dog, 298.
  Pygmy Rabbit, 845.
  Red-squirrel, 149.
  Rockchuck, 349.
  Roundtailed Muskrat, 565.
  Say's Chipmunk, 225.
  Snowshoe Rabbit, 733.
  Striped Ground-squirrel, 248.
  Swamp-rabbit, 827.
  Whitetailed Jack, 665.
  Woodchuck, 336.
Reid, Capt. Mayne (1818–1883), U. S. A., Mexican War traveller and novelist,
  on Gray-squirrel numbers in Kentucky, 21.
  on winter-killed Muskrats, 593.
Reptiles eaten by Striped Ground-squirrel, 238.
  see also Snake.
Restoration of Gray-squirrel, 25.
restrictus, Sylvilagus, 783.
Reynolds, E. W., of Winsted, Conn., on Woodchuck, mother love, 318.
Rhoads, Dr. Samuel Nicholson (1862–), zoologist and bibliophilist, Phila., Pa.,
  on Beaver numbers in New Jersey, 451.
  on Beaver numbers in Pennsylvania, 451.
  on Chipmunk cannibalism, 201.
  on Chipmunk family life, 195.
  on Chipmunk gestation, 194.
  on Chipmunk mating, 192.
  on no fat Chipmunks in October, 214.
  on Chipmunk young, 193.
  on Porcupine weight, 605.
Rice, Serg. George W., photographs of the Greely Exped., 1881, on Greenland Hare gait, 696.
Richardson, Dr. John (1787–1865) (later Sir John), naturalist on Parry & Franklin expeds.,
  establishes genus Aplodontia, 529.
  on Arctic Hare food, 673.
  on Arctic Hare hunting, 678.
  on Arctic Hare names, 668.
  on Arctic Hare weight, 668.
  on Arctic Hare young, 675.
  on Beaver disease, 489.
  on Beaver flesh, 454.
  on Beaver food, 483.
  on Beaver playfulness, 482.
  on Beaver teats, 443.
  on Beaver voice, 478.
  discovers Citellus franklinii, 250.
  on Coney names, 636.
  discovers Flickertail, 260.
  on Gopher and earthworms, 412.
  on Gopher names, 396.
  on Gray-squirrel at Lakes Huron and Superior, 11.
  on Hoary Marmot cutting hay, 356.
  on Hoary Marmot voice, 357.
  on Muskrat food, 581.
Richardson (*Continued*)
  on Muskrat *vs.* Beaver, 491, 495.
  on Otter *vs.* Beaver, 491.
  on Porcupine mating, 614.
  on Porcupine names, 604.
  on Striped Ground-squirrel range, 231.
  on Woodchuck names, 300.
richardsoni, Citellus, 260.
  Sciurus, 119.
richardsonii, Arctomys, 260.
  Citellus, 260.
  Lepus, 737.
Riley, Smith (1878–), of Washington, D. C., on Beaver numbers, 449.
Ringle, Harry A., on drowning Prairie-dogs, 289.
  on Prairie-dog and rattlers, 295.
Rink, Dr. Henry John (1819–1894), Danish naturalist and explorer,
  on Greenland Hare numbers in Greenland, 685.
ripensis, Ondatra, 570.
Risteen, Frank Havelock ("Prowler"), (1861–1910), on Big Flying-squirrel carrying off lighted candles, 391.
rivalicia, Ondatra, 571.
Robe, Hoary Marmot, 353.
  Mountain Beaver, 526, 553.
  Snowshoe Rabbit, 727.
Roberts, A. A., professional trapper, Dorset, Vt., gets Opossum in Vermont, 869.
Robillard, Elzear, half-breed trapper on Great Slave River, on Porcupine home range, 606.
Robinson, Miss E. A., of Northport, Long Island, N. Y., on game between Squirrels and Cottontail, 35, 812.
Robinson, E. P., of Packerville, Conn., on Muskrat games, 581.
  on Muskrat under water, 580.
Robinson, Col. Wirt, U. S. A. (1864–), West Point, N. Y., on torpid Chipmunk, 213.
  on Woodchuck swimming, 312.
robustus, Sylvilagus, 783.
Rockchuck, contents, 337; life, 338; (ill.), 326; castles (ill.), 348; feet (ill.), 346; map, 341; nest (ill.), 346.
Rock-squirrel, *see* Chipmunk, Say's.
Rodentia Order, characteristics of, 1.
Roe, Mrs. F. A., of Ormond, Fla., on Fox-squirrel age, 106.
Rogers, Leo, of Manchester, Eng., on earthworms, 413.
Rogers, Thomas, father of Rogers, Leo, 413.
Roller-tail, *see* Muskrat, Roundtailed.
Roosevelt, Theodore (1858–1919), Pres. U. S., 1901–09,
  on Armadillo dug up with steam shovel, 854.
  on Armadillo when pursued, 857.
  on eagle *vs.* Whitetailed Jack, 661.
  urges E. T. S. to write, ix.
  on *Life Histories of Northern Animals*, ix.
Rosenberger, Dr. Randle C., of Pennsylvania, on Gray-squirrel falling, 37.
Ross, Alexander (1783–1856), fur-trader and pioneer of British America, on Beaver numbers, 448.

Ross, B. E., merchant of Albert Lea, Minn., on fighting Muskrat, 596.
Ross, Capt. Sir James Clark (1800–1862), nephew of Sir John Ross, Arctic explorer,
  on Arctic Hare change of colour, 669.
  on Arctic Hare haunts, 670.
  on Arctic Hare tamability, 677.
  on Arctic Hare young, 675.
  on Greenland Hare wool, 683.
Rosser, J. J. G., Hudson's Bay Co. factor at Winnipegosis, Man., on Chipmunk range, 187.
Rossiter, P. K., of Ithaca, N. Y., on Woodchuck weight, 301.
Roundtailed Muskrat, *see* Muskrat, Roundtailed.
Rubber eaten by Porcupine, 627.
rufa, Anisonyx, 526.
  Aplodontia, 526, 527.
rufescens, Marmota, 303.
  Thomomys talpoides, 397.
rufiventer, Sciurus, 83.
Rumball, Dr. M. C., of Morden, Man., on Red-squirrel numbers, 119.
Runcies, Dr. G. T., of Roachdale, Ind., on Cottontail freak teeth, 787.
Runways, Mountain Beaver, 531.
rupicola, Neotoma, [illegible].
russatus, Sylvilagus, 783.
Russula as food of Red-squirrel, [illegible].

SABRINUS, Glaucomys, 386, 387.
  Sciurus, 386.
Salamander, in den of Ground-squirrel, 233.
Salt as Porcupine lure, 617.
Salt-lick, Antelope Jack, 773; (ill.), 777.
Sanctuaries, Cottontail, 801.
Sanctuary, Beaver respond to, 488.
  Cottontail and, 798.
  Snowshoe Rabbit and, 723.
Sand-rat, Canada, *see* Gopher.
Sanitation, Antelope Jack, 773; (ill.), 777.
  Beaver, 490.
  Cats, 138.
  Cottontail, 800.
  Deer, 138.
  Field-mice, 137.
  Fox-squirrel, 94.
  Fremont Squirrel, 168.
  Gopher, 408.
  Gray-squirrel, 38.
  Ground-squirrels, 138.
  Hoary Marmot, 356.
  Kangaroo-rat, 429.
  methods in general, 137.
  Mountain Beaver, 540.
  Muskrat, 587.
  Opossum, 894.
  Pocket-gophers, 138.
  Red-squirrel, 137.
  Snowshoe Rabbit, 729.
  Woodchuck, 325.
Sap as Fox-squirrel food, 89.
Saskatchewan, Beaver numbers in, 451.
  Cottontail in, 786.
  Opossum in, 870.
  Prairie-dog in, 278.
saturatus, Callospermophilus, 219.
  Glaucomys, 369.
Saumenig, Rev. H. Fields, of Rome, Ga., on Cottontail *vs.* snake, 813.
Sawyer, Edmund Joseph (1880–), naturalist, Yellowstone Park,
  on Beaver driving stakes, 463.
  on Beaver in Wyoming, 452.
saxamans, Neotoma, 505.
saxatilis, Ochotona, 637.
Say, Thomas (1787–1834), naturalist of Long's Exped., 1819–20, etc., on Beaver cutting trees, 460.
Sayles, Ira, of Rushford, N. Y., on Chipmunk storage, 204.
Say's Chipmunk, *see* Chipmunk, Say's.
Scatology, *see* Dung.
Scats, *see* Dung.
Scha-ghern-uh, *see* Squirrel, Abert's.
Scheffer, Theophilus H. (1867–), U. S. Biol. Surv., Puyallup, Wash.,
  on Beaver gestation, 473.
  on Mountain Beaver nests, 541.
  on Mountain Beaver young, 542.
Schist, *see* Micaceous schist.
schisticeps, Ochotona, 637.
Sciuridæ Family, characteristics of, 1, 9.
Sciurus, genus, characteristics of, 1, 9.
  aberti, 68, 69.
  albolimbatus, 152.
  anthonyi, 60.
  apache, 108.
  arizonensis, 112.
  avicennia, 84.
  baileyi, 119.
  barberi, 69.
  bryanti, 84.
  carolinensis, 9, 10.
  cascadensis, 152.
  dakotensis, 118.
  durangi, 69.
  douglasii, 152.
  extimus, 11.
  ferreus, 69.
  fremonti, 162.
  fuliginosus, 11.
  grahamensis, 163.
  griseus, 69.
  gymnicus, 118.
  huachuca, 112.
  hudsonicus, 117, 118.
  hypophæus, 11.
  kaibabensis, 69.
  lateralis, 218.
  leucotis, 10.
  limitis, 83.
  loquax, 118.
  lychnuchus, 163.
  mearnsi, 152.
  mimus, 69.
  minnesota, 118.
  mogollonensis, 162.
  mollipilosus, 152.
  neglectus, 83.
  neomexicanus, 162.

Sciurus (*Continued*)
  niger, 82, 83.
  nigripes, 60.
  petulans, 119.
  phæurus, 69.
  picatus, 119.
  richardsoni, 119.
  rufiventer, 83.
  sabrinus, 386.
  streatori, 119.
  striatus, 184.
  texianus, 83.
  tridecemlineatus, 228.
  vancouverensis, 119.
  ventorum, 119.
  vulgaris hudsonicus, 117.
Scollan, George, Manitoba settler, on Muskrat fight, 594.
Scorpion, enemy to Kangaroo-rat, 434.
Scott, George A., M. L. A., on Porcupine weight, 605.
Scrub-gopher, *see* Ground-squirrel, Franklin.
Sears, George W. ("Nessmuk") (1821–1890), Adirondack woodcrafter,
  on Gray-squirrel numbers in Michigan, 23.
Selwyn, Percy H., Can. Geol. Surv. Ottawa, Ont.,
  on Snowshoe Rabbit nest, 720.
  on Whitetailed Jack young, 656.
Senses, Greenland Hare, 696.
Sentinel, Hoary Marmot, 359;(ill.), 362.
Seven-sleeper, 319; (ill.), 299.
Sewellel, *see* Mountain Beaver.
  named by Clark, 528.
Shafts, Gopher, 408.
Sha-ka-skan-da-way, *see* Flying-squirrel, Big.
Sha-ka-skan-da-way-o, *see* Flying-squirrel, Big.
Sha-sha-ba Wa-ba-coosh, *see* Ground-squirrel, Striped.
shastensis, Castor, 445.
Shaw, L. V., of Clements Port, N. S., on Porcupine shooting quills, 620.
Sheldon, Charles (1867–1928), naturalist, Washington, D. C.,
  on Hoary Marmot numbers, 354.
  on Hoary Marmot spring appearance, 359.
sheldoni, Marmota, 353.
Shelly, Dr. J. J., of Stony Run on Packrat collection, 521.
Shelton, Edward Mason (1846–), agriculturist, Seattle, Wash., on Mountain Beaver damage, 543.
Sheperd, Smiley, of Hennepin, Ill., on Fox-squirrel storing in forks of trees, 92.
Sherman, F. C., of Chicago, on Franklin Ground-squirrel climbing, 251.
Sherman, Harley B., biologist, Univ. Fla., associate of L. R. Dice.
Sherzer, Prof. William Hittell (1860–), of Ypsilanti, Mich., State Normal,
  on Cotton-tail running to man for protection against Weasel, 798.
She-wal-lal or Mountain Beaver robe, 528.
  see also Mountain Beaver.
Shiras, Hon. George, 3rd (1859–), zoologist, Washington, D. C.,
  on albino Porcupine, 605.
Shooting quills, Porcupine, 620.
Showhurll, *see* Mountain Beaver.
Showt'l, *see* Mountain Beaver.
Shukata, *see* Opossum.
Shyness, Antelope Jack, 773.
  Arctic Hare, 674.
  Greenland Hare, 692.
Sidling, Gray-squirrel, 49.
sierræ, Lepus, 650.
  Marmota, 339.
Siffleur, *see* Marmot, Hoary.
  see also Woodchuck.
Signalling, Beaver, 478.
  Cottontail, 789.
  Muskrat, 585.
  Packrat, 512.
  Snowshoe Rabbit, 733.
  Swamp-rabbit, 824.
  see also Drumming.
  see also Glands.
Silver, James (1890–), U. S. Biol. Surv.,
  on European Hare, 666.
Silver storm, enemy to Gray-squirrel, 56.
Silver-tail, *see* Squirrel, Abert's.
  see also Gray-squirrel.
similis, Sylvilagus, 782.
Simmons, Col., early settler in Wash. Terr., on Mountain Beaver voice, 551.
Simplicity, Greenland Hare, 692.
Singer, Red-squirrel, home range of, 122.
  nest examined, 127.
  trains young, 141.
  voice of, 143.
Singteshda-tanka, *see* Opossum.
Sink-pay-lah, *see* Muskrat.
Sisson, A. C., farmer, La Plume, Pa., on Woodchuck damage, 309.
Size, Abert's Squirrel, 69.
  Antelope Jack, 764.
  Apache Squirrel, 108.
  Arctic Hare, 668.
  Arizona Gray-squirrel, 112.
  Armadillo, 848.
  Beaver, 443.
  Beaver dams, 463.
  Big Flying-squirrel, 386.
  Blacktailed Jack, 736.
  Brush-rabbit, 818.
  California Gray-squirrel, 60.
  Chipmunk, 184.
  Coney, 637.
  Cottontail, 782.
  Douglas Squirrel, 152.
  European Hare, 666.
  Flickertail, 260.
  Fox-squirrel, 82.
  Franklin Ground-squirrel, 250.
  Fremont Squirrel, 162.
  Gopher, 397.
  Gray-squirrel, 9.
  Greenland Hare, 682.

- Size (*Continued*)
  - Hoary Marmot, 352.
  - Kangaroo-rat, 420.
  - Least Chipmunk, 171.
  - Little Flying-squirrel, 368.
  - Marsh-rabbit, 830.
  - Mountain Beaver, 527.
  - Muskrat, 569.
  - Opossum, 866.
  - Packrat, 504.
  - Porcupine, 604.
  - Prairie-dog, 276.
  - Pygmy Rabbit, 840.
  - Red-squirrel, 117.
  - Roundtailed Muskrat, 558.
  - Rockchuck, 338.
  - Say's Chipmunk, 218.
  - Snowshoe Rabbit, 700.
  - Striped Ground-squirrel, 229.
  - Swamp-rabbit, 822.
  - Whitetailed Jack, 648.
  - Woodchuck, 301.
- Skinner, Milton Philo, of Jamestown, N. Y. (1879–   ), on Coney in winter, 644.
- Skua, enemy to Arctic Hare, 673.
- Skull, Arctic Hare (ill.), 693.
  - Beaver (ill.), 293.
  - California Gray-squirrel (ill.), 64.
  - Greenland Hare (ill.), 693.
  - Kangaroo-rat (ill.), 432.
  - Opossum (ill.), 883.
  - Packrat (ill.), 509.
  - Prairie-dog (ill.), 293.
  - Raccoon (ill.), 883.
  - Red-squirrel (ill.), 432.
  - Say's Chipmunk (ill.), 236.
  - Striped Ground-squirrel (ill.), 236.
- Skunk, enemy to Blacktailed Jack, 751.
  - enemy to Cottontail, 797.
  - enemy to Mountain Beaver, 542.
  - enemy to Packrat, 510.
  - killed by Cottontail, 813.
  - *vs.* Porcupine, 625.
- Slaughter, *see* Destruction.
- Slautterback, John J., Game Warden, Harrisburg, Pa., on Beaver numbers in Penn., 452.
- Sleeping, Whitetailed Jack, 653.
  - Blacktailed Jack, 753; (ill.), 750.
- Sloths, Order, characteristics of, 5.
- Smith, Dr. Gideon B., editor, Phila., Pa.,
  - on Little Flying-squirrel docility, 381.
  - on Little Flying-squirrel home range, 369.
  - on Little Flying-squirrel numbers, 369.
  - on Little Flying-squirrel sociability, 372.
- Smith, Horace G., Jr., ornithologist, of Denver, Colo., on Striped Ground-squirrel as birdicide, 238.
- Smith, John D., taxidermist, Bost. Soc. Nat. Hist. on Opossum in New Hampshire, 869.
- Snakes eaten by Armadillo, 856.
  - enemy to Blacktailed Jack, 752.
  - enemy to Gopher, 405.
  - enemy to Gray-squirrel, 53.
  - enemy to Packrat, 510.
- Snakes (*Continued*)
  - enemy to Prairie-dog, 296.
  - fought by Cottontail, 812, 813.
  - *see also* Reptiles.
- Snapping turtle attacked by Porcupine, 623.
  - enemy to Red-squirrel, 126.
- Snare takes two Rabbits at once, 728.
  - Rabbit (ill.), 719.
- Snowdrift playground, Red-squirrel, 144.
- Snowshoe Rabbit, contents, 699; life, 700; (ill.), 702, 706; feet (ill.), 719; map, 739; poses (ill.), 731; in summer coat (ill.), 702; in white coat (ill.), 706; tail (ill.), 756; tracks (ill.), 719; young (ill.), 726.
- Snowshoes, Snowshoe Rabbit, 703.
- Snow tunnels, Gopher, 410; (ill.), 411.
  - Mountain Beaver, 535.
- Snyder, Lester Lynne (1894–   ), Royal Ont. Mus. Zool., Toronto,
  - on Little Flying-squirrel nest, 377.
- Soap eaten by Porcupines, 627.
- Sociability, Abert Squirrel, 70.
  - Antelope Jack, 773.
  - Arctic Hare, 675.
  - Armadillo, 860.
  - Beaver, 478.
  - Big Flying-squirrel, 388.
  - Blacktailed Jack, 746.
  - Chipmunk, 195.
  - Douglas Squirrel, 153.
  - Flickertail, 265.
  - Fox-squirrel, 98.
  - Franklin Ground-squirrel, 253.
  - Gopher, 401.
  - Gray-squirrel, 34.
  - Greenland Hare, 694.
  - Hoary Marmot, 359.
  - Kangaroo-rat, 429, 431.
  - Little Flying-squirrel, 372, 383.
  - Mountain Beaver, 531, 550.
  - Muskrat, 585.
  - Opossum, 884.
  - Packrat, 511.
  - Porcupine, 611.
  - Pygmy Rabbit, 843.
  - Red-squirrel, 144.
  - Snowshoe Rabbit, 730.
  - Striped Ground-squirrel, 231.
  - Whitetailed Jack, 654.
- Sod-runner, *see* Ground-squirrel, Striped.
- Solitary, *see* Sociability.
- Somersaults of Little Flying-squirrel, 382.
- Song, Gray-squirrel, 41.
  - *see also* Voice.
- sonoriensis, Dipodomys, 421.
- Soper, Joseph Dewey, zoologist, Nat. Mus., Ottawa, acknowledgment to, vi.
  - on Big Flying-squirrels eating apples, 390.
  - on Big Flying-squirrel tamability, 393.
  - on Cottontail in Ontario, 784.
  - on Flickertail *vs.* Weasel, 272.
  - on Muskrat shifting population, 575.
  - on Snowshoe Rabbit cannibalism, 717.
  - on Snowshoe Rabbit moonlight gathering, 730.

Soper (*Continued*)
  on Snowshoe Rabbit swimming, 716.
  on Snowshoe Rabbit years, 708.
  on Woodchuck spring advent, 323.
Sophia (wild mustard) as Kangaroo-rat food, 426.
Souslik, *see* Ground-squirrel, Franklin.
  Canada, *see* Flickertail.
  Spotted, *see* Ground-squirrel, Striped.
  Yellow, *see* Flickertail.
Southwick, Prof. Edmund Bronk (1848–), naturalist, Arsenal Bldg., Central Park, N. Y. C.,
  on contents of Red-squirrel nests, 127.
Sparrow-hawk as enemy to Red-squirrel, 124.
Sparrows charmed by Chipmunk song, 208.
  entertained by Gray-squirrel, 41.
spatulata, Ondatra, 570.
Spears, Raymond Smiley (1876–), hunter-naturalist,
  on melano Woodchuck, 302.
  on Woodchuck numbers, 305.
  on Woodchuck voice, 314.
  on Woodchuck way of life, 332.
Species of Coney, 636.
Speed, Antelope Jack, 773.
  Arctic Hare, 674.
  Armadillo, 856.
  Beaver, 472.
  Blacktailed Jack, 753.
  Cottontail, 793.
  Flickertail, 269.
  Franklin Ground-squirrel, 254.
  Gray-squirrel, 38.
  Kangaroo-rat, 434.
  Little Flying-squirrel on revolving wheel, 382.
  Marsh-rabbit, 835.
  Mountain Beaver, 538, 544.
  Muskrat, 580.
  Porcupine, 610.
  Snowshoe Rabbit, 714.
  Striped Ground-squirrel, 234.
  Whitetailed Jack, 657.
Spencer, Miles, trader, Fort George, H. B.,
  on Muskrat breeding, 598.
Spermophile, *see* Flickertail.
  Franklin, *see* Ground-squirrel, Franklin.
  Gray-cheeked, *see* Ground-squirrel, Franklin.
  Hood, *see* Ground-squirrel, Striped.
  Leopard, *see* Ground-squirrel, Striped.
  Thirteen-striped, *see* Ground-squirrel, Striped.
Sphærostigma (evening primrose) as Kangaroo-rat food, 426.
Splash, Beaver, 478.
Split toe nail, Beaver, 494; (ill.), 456.
Spotted fever carried by Flickertail, 273.
  carried by Rockchuck, 344.
Springbok, migration, 20.
Spy-hop, Antelope Jack, 773.
  Blacktailed Jack (ill.), 750.
  Greenland Hare, 695.
  Snowshoe Rabbit, 714.
  Whitetailed Jack, 658; (ill.), 750.
Squallah, *see* Mountain Beaver.
Squires, Mrs. Nathan C., on Gray-squirrel in New Brunswick, 13.
Squirrel, Abert's, contents, 67; life, 68; map, 12.
  Abert's Pine, *see* Squirrel, Abert's.
  Apache, contents, 107; life, 108; map, 85.
  Apache Fox, *see* Squirrel, Apache.
  Arizona, *see* Gray-squirrel, Arizona.
  Banded-back, *see* Squirrel, Apache.
  Big, *see* Flickertail; *also* Ground-squirrel, Franklin.
  Black, *see* Gray-squirrel; *also* Squirrel, Abert's.
  Calico, *see* Chipmunk, Say's.
  Chipping, *see* Chipmunk.
  Distribution of (map), 174.
  Douglas, contents, 151; life, 152; contrasted with Red-squirrel, 117; map, 164; track (ill.), 157.
  Family, characteristics of, 1, 9.
  Flag, *see* Ground-squirrel, Striped.
  Flying, *see* Flying-squirrel.
  Fox, *see* Fox-squirrel.
  Fremont's, contents, 161; life, 162; contrasted with Red-squirrel, 117; map, 164.
  Gray, *see* Gray-squirrel.
  Gray Tree, *see* Gray-squirrel, California.
  Ground, *see* Ground-squirrel.
  Migratory, *see* Gray-squirrel.
  Pine, *see* Red-squirrel.
  Prairie, *see* Ground-squirrel, Franklin.
  Red, *see* Red-squirrel.
  Red-tailed, *see* Fox-squirrel.
  Rock, *see* Chipmunk, Say's.
  Rusty, *see* Red-squirrel.
  Saddle-backed, *see* Squirrel, Abert's.
  Tassel-eared, *see* Squirrel, Abert's.
  Tiger, *see* Chipmunk, Say's.
  Tufted-eared, *see* Squirrel, Abert's.
  Whistling, *see* Ground-squirrel, Franklin.
  Whitetailed, *see* Squirrel, Abert's.
  Yellow-bellied, *see* Fox-squirrel.
  Yellow-breasted Pine, *see* Squirrel, Douglas.
  Yellow Prairie, *see* Flickertail.
Squirrill, Mouse-, *see* Chipmunk.
Stack, Prof. Joseph William (1893–), forester, Lansing, Mich., on Little Flying-squirrel mother love, 378.
Stain on Arizona Gray-squirrel pelage, 113.
  on Fremont Squirrel pelage, 168.
Stamping, Cottontail, 789.
  Snowshoe, 733.
  see also Drumming.
Stanley, A. J., on California Gray-squirrel disease, 65.
Stanley, Gen. David Sloan (1828–1902), of Fort Sully, Dak.,
  on Wolverine *vs.* Beaver, 493.
Stealing nuts from Packrats, 519.
Stefansson, Vilhjalmur (1879–), anthropologist, Arctic explorer,
  on Arctic Hare numbers, 671.
Stephens, Frank (1849–), mammalogist, Nat. Hist. Mus., San Diego, Calif., acknowledgment to, v.
  on California Gray-squirrel disease, 65.
  on California Gray-squirrel nest, 62.
  on California Gray-squirrel storage, 61.
  on California Gray-squirrel voice, 62.

Stephens (*Continued*)
    on California Gray-squirrel way of life, 63.
    on California Gray-squirrel young, 63.
    on Douglas Squirrel food, 155.
    on Douglas Squirrel mating, 154.
    on Douglas Squirrel voice, 154.
    on Douglas Squirrel in winter, 154.
    on Douglas Squirrel young, 154.
    on Kangaroo-rat dust bath, 429.
    on Kangaroo-rat food, 424.
    on Kangaroo-rat speed, 434.
    on Kangaroo-rat storage, 424.
    on Mountain Beaver feeding habits, 537.
    on Mountain Beaver haunts, 531.
    on Mountain Beaver haymaking, 539.
    on Mountain Beaver water control, 535.
    on Rabbit epidemic, 752.
stephensi, Glaucomys, 388.
Stewart, Dr. D. A. (1874–), of the Sanitarium, Ninette, Man., on Snowshoe Rabbit year, 706.
Stiles, Dr. Charles Wardell (1867–), medical zoologist, Hygienic Lab., Washington, D. C.,
    on Whitetailed Jack parasites, 663.
Stoddard, Herbert L., of Beachton, Ga., on Little Flying-squirrel as birdicide, 374.
    on Fox-squirrel nest and young, 94.
Stone, Dr. Witmer (1866–), zoologist, Phila. Acad. Nat. Sci.,
    on Woodchuck eating cantaloupes, 308.
Storage, Abert Squirrel, 77.
    Beaver, 4[illegible]4.
    California Gray-squirrel, 61.
    Chipmunk, 201.
    Flickertail, 270.
    Fox-squirrel, 91.
    Fremont Squirrel, 166.
    Gopher, 401.
    Gray-squirrel, 30.
    Kangaroo-rat, 424.
    Least Chipmunk, 176.
    Muskrat, 584.
    Packrat, 519.
    Red-squirrel, 133.
    Say's Chipmunk, 222.
    Striped Ground-squirrel, 240.
Storer, Tracy Irwin (1889–), zoologist, Univ. Calif.
    on California Gray-squirrel nest, 52.
    on California Gray-squirrel young, 63.
    see also Grinnell, J.
Storey, T. J., taxidermist, Duluth, Minn., on Gray-squirrel in Duluth, Minn., 11.
Storms as enemy to Gray-squirrel, 56.
Streator, Clark Perkins, field naturalist, Santa Cruz, Calif., on owl as Gopher enemy, 405.
    on Rabbit epidemic, 753.
streatori, Sciurus, 119.
Strecker, John Kern, of Baylor Univ., Waco, Tex., on Armadillo haunts, 853.
    on Armadillo in Louisiana, 852.
    on Armadillo in Texas, 851.
Strength, Armadillo, 861.
    Red-squirrel, 143.
striatus, Sciurus, 184.
    Tamias, 184, 185.
Striped Ground-squirrel, *see* Ground-squirrel, Striped.
Striper, *see* Ground-squirrel, Striped.
    Prairie, *see* Ground-squirrel, Striped.
Stripsie, *see* Ground-squirrel, Striped.
Struthers, Parke Hardy (1891–), mammalogist, Chesham, N. H., acknowledgment to, vi.
    on Porcupine borning, 614.
    on Porcupine copulation, 614.
    on Porcupine damage, 617.
    on Porcupine mating, 614.
    on Porcupine numbers in New Hampshire, 608.
    on Porcupine voice, 612.
    on Porcupine weight, 604.
    on Porcupine young, 615.
struthopus, Lepus, 701.
Stupidity, Packrat, 513.
    Porcupine, 610.
    see also Intelligence.
Stryker, Carol (1899–), of Staten Island Mus., N. Y.,
    on Abert Squirrel nest, 73.
    on horned owl *vs.* Packrat, 510.
subauratus, Castor, 445.
subcinctus, Sylvilagus, 783.
Suckley, Dr. George, U. S. A. (1830–1869), Western naturalist, *circa* 1860, on Mountain Beaver habits, 529.
    on Mountain Beaver hibernation, 547.
    on Mountain Beaver voice, 551.
Suisse, *see* Chipmunk.
    le petit, *see* Least Chipmunk.
Sunbath, Armadillo, 853.
    Cottontail, 801.
    Gopher, 408.
    Hoary Marmot, 361.
    Opossum, 894.
Superior, Lake, Gray-squirrel at, 11.
Surface, Prof. Harvey Adam (1867–), of Harrisburg State Museum, has hoofed Muskrat, 580
Sverdrup, Otto (Neumann) (1855–), Arctic explorer, on Greenland Hare migration, 689.
    on Greenland Hare numbers on Ellesmere Id., 687.
    on Greenland Hare numbers on Oscar Land, 686.
    on Greenland Hare sociability, 694.
Swarth, Dr. Harry Schelwald (1878–), zoologist, Calif. Acad. Sci., on Hoary Marmot young, 358.
Swimming, Arctic Hare, 674.
    Armadillo, 860.
    Beaver, 472.
    Big Flying-squirrel, 389.
    Chipmunk, 212.
    Cottontail, 794.
    Gray-squirrel, 15.
    Little Flying-squirrel, 375.
    Marsh-rabbit, 835.
    Mountain Beaver, 544.
    Muskrat, 580.
    Porcupine, 610.
    Red-squirrel, 120.

- Swimming (*Continued*)
  - Roundtailed Muskrat, 564.
  - Snowshoe Rabbit, 714.
  - Swamp-rabbit, 825.
  - Whitetailed Jack, 658.
  - Woodchuck, 312.
- Sylvilagus, genus, characteristics of, 4, 781.
  - alacer, 783.
  - aquaticus, 822, 823.
  - aztecus, 783.
  - bachmani, 818.
  - cerrosensis, 819.
  - chapmani, 783.
  - chiapensis, 783.
  - cinerascens, 819.
  - cognatus, 783.
  - connectens, 783.
  - exiguus, 819.
  - floridanus, 781, 782.
  - hitchensi, 782.
  - holzneri, 783.
  - littoralis, 823.
  - mallurus, 782.
  - mansuetus, 819.
  - mearnsii, 782.
  - orizabæ, 783.
  - paludicola, 831.
  - palustris, 830, 831.
  - peninsularis, 819.
  - restrictus, 783.
  - robustus, 783.
  - russatus, 783.
  - similis, 782.
  - subcinctus, 783.
  - transitionalis, 783.
  - ubericolor, 818.
  - yucatanicus, 783.
- Symington, Robert B., of Massachusetts, on bullfrog killing Chipmunk, 197.

- TÆNIA, parasite of Whitetailed Jack, 663.
- Tah-sen-a A-das-ka, *see* Ground-squirrel, Striped.
- Tail, Abert Squirrel, 70.
  - Antelope Jack (ill.), 756.
  - Arctic Hare (ill.), 756.
  - Armadillo, 849.
  - Beaver, 458; (ill.), 486.
  - Blacktailed Jack (ill.), 756.
  - Brush-rabbit (ill.), 756.
  - Cat, use of, 36.
  - Cottontail (ill.), 756.
  - Geomyidæ, 396.
  - Gray-squirrel, 36.
  - Fox-squirrel, 102.
  - Muskrat (ill.), 573.
  - Opossum, 867, 872; carrying bedding (ill.), 883.
  - Packrat (ill.), 509.
  - Pygmy Rabbit (ill.), 756.
  - Red-squirrel tender, 122.
  - Snowshoe Rabbit (ill.), 756.
  - Whitetailed Jack (ill.), 756.
- talpoides, Cricetus, 386.
  - Thomomys, 396, 397.
- Tamability, Arctic Hare, 677.
  - Armadillo, 860.
  - Big Flying-squirrel, 393.
  - Cottontail, 807.
  - Fox-squirrel, 105.
  - Gray-squirrel, 50.
  - Least Chipmunk, 179.
  - Little Flying-squirrel, 381.
  - Marsh-rabbit, 833.
  - Mountain Beaver, 537, 550.
  - Opossum, 887.
  - Prairie-dog, 292.
  - Whitetailed Jack, 657.
  - Woodchuck, 326.
- Tamias genus, characteristics of, 1, 184.
  - fisheri, 185.
  - griseus, 185.
  - lysteri, 185.
  - minimus, 170.
  - striatus, 184, 185.
  - venustus, 185.
- Tanner, John (1780?–1847), famous frontiersman, of Minn. region, on Beaver disease, 489.
- Tapeworm, parasite to Porcupine, 624.
  - parasite to Whitetailed Jack, 663.
- Tappan, N. Y., Red-squirrel at, 122.
- Tash-nah-hay-ah-lah, *see* Ground-squirrel, Striped.
- Tash-nah-hay-ho-tah, *see* Flickertail.
- Tassel-eared Squirrel, *see* Squirrel, Abert's.
- Taverner, Percy Algernon (1875–), ornithologist, Nat. Mus. Canada, Ottawa,
  - on Cottontail in Saskatchewan and Alberta, 786.
  - on Fox-squirrel tamability, 105.
  - on Gray-squirrel range, 11.
  - on Porcupine love song, 612.
- Taxes paid in Squirrel scalps, 21.
- Taylor, Mrs. R. G., of Swan River, Man., on Red-squirrel eating wasp combs, 133.
- Taylor, Walter Penn (1888–), zoologist, Tucson, Ariz., acknowledgment to, vi.
  - on Beaver in California, 452.
  - on Douglas Squirrel haunts, 153.
  - on Mountain Beaver life history, 529.
  - on Mountain Beaver names, 526, 554.
  - on Mountain Beaver races, 527.
  - on Say's Chipmunk caches, 222.
  - on Say's Chipmunk voice, 223.
- Tcha-pa, *see* Beaver.
- Tear fluid, Mountain Beaver, 527, 542.
- Teeth, Armadillo, 848.
  - Beaver, 443, 457.
  - Chipmunk, 184.
  - Coney, 636.
  - Cottontail, freak, 787; (ill.), 805.
  - Gray-squirrel, 9.
  - Kangaroo-rat, 420.
  - Least Chipmunk, 170.
  - Little Flying-squirrel, 368.
  - Mountain Beaver, 526.
  - Muskrat, 569.
  - Opossum, 866.
  - Packrat, 504; (ill.), 509.
  - Porcupine, 604.
  - Say's Chipmunk, 218.

Teeth (Continued)
    Striped Ground-squirrel, 228.
    Whitetailed Jack, 648.
    Woodchuck, 311, freak, 322, (ill.), 322.
Temper, Cottontail, [illegible].
Tenacity of Life, Striped Ground-squirrel, 237.
Teonoma genus, characteristics of, 504.
tescorum, Callospermophilus, 219.
Testes, Mountain Beaver, 527.
texanus, Dasypus, 850.
Texas, Armadillo in, 851.
texensis, Castor, 445.
    Citellus, 229.
    Glaucomys, 360.
texianus, Lepus, 737.
    Sciurus, 83.
Thal-[illegible]-zay, *see* Least Chipmunk.
Thatcher, A. C., of Urbana, O., on Cottontail cannibalism, 792.
Thee, *see* Porcupine.
Thel-lee-cho, *see* Woodchuck.
Thickwood Badger, *see* Woodchuck.
Thomas, Craig S., ornithologist, Vermilion, So. Dak., in defense of Red-squirrel, 136.
Thomas, Chauncey, journalist, Denver, Colo., on Whitetailed Jack doubling, 660.
Thomomys, genus, characteristics of, 2, 396.
    alpinus, 397.
    bottæ, 397.
    bulbivorus, 397.
    douglasii, 397.
    fossor, 397.
    fulvus, 397.
    fuscus, 397.
    monticola, 397.
    perpallidus, 397.
    talpoides, 396, 397.
    talpoides agrestis, 398.
    talpoides bullatus, 398.
    talpoides caryi, 398.
    talpoides clusius, 397.
    talpoides columbianus, 398.
    talpoides idahoensis, 398.
    talpoides nebulosus, 398.
    talpoides ocius, 398.
    talpoides pryori, 398.
    talpoides pygmæus, 398.
    talpoides rufescens, 397.
    townsendii, 397.
    umbrinus, 397.
Thompson, John B., editor *Sporting Goods Journal*, Chicago, on Gray-squirrel numbers in Missouri, 26.
Thompson, Raymond, field naturalist, on Beaver repair work, 463.
    on trapping Beaver, 487.
Thompson, Dr. Samuel J., V. S. of Carberry, Man.,
    on Whitetailed Jack range, 651.
    on Whitetailed Jack *vs.* Fox, 662.
    on Whitetailed Jack weight, 649.
Thompson, Will Henry (1848–1908?), famous archer, on Cottontail *vs.* Skunk, 813
Thornbush, Kangaroo-rat, 429.
tiburonensis, Lepus, 765.
Ticks, *see* Parasites.
Tiger-squirrel, *see* Chipmunk, Say's.
Till-keha, *see* Prairie-dog.
Ti-tcel-is, *see* Gray-squirrel, California.
Toad, parasite of Gopher, 407.
Todd, William, of Richmond, Va., on pickerel as enemy to Red squirrel, 125.
Tolling Beaver, 480.
Tongue, Armadillo, 849.
Torpidity, Snowshoe Rabbit, 729.
    see also Cold Sleep, and Hibernation.
Tousa, *see* Prairie-dog.
Towns, Mountain Beaver, *see* Colonies.
Townsend, Dr. Charles Haskins (1859–), zoologist, director N. Y. Aquarium,
    on California Gray-squirrel names, 60.
    on California Gray-squirrel way of life, 65.
    on Mountain Beaver haunts, 530.
    on Mountain Beaver haymaking, 538.
    on Opossum cleanliness, 894.
    on Opossum food and drink, 890.
    on Opossum in New York, 869.
    on Opossum tail, 873.
    on Opossum tamability, 887.
Townsend, John Kirk (1809–1851), Western traveller, on Douglas Squirrel family life, 154.
    on Douglas Squirrel food, 155.
townsendii, Eutamias, 170.
    Lepus, 648, 650.
    Thomomys, 397.
Track, Arctic Hare, 824.
    Blacktailed Jack, 749; (ill.), 750.
    Cottontail, 824; (ill.), 750, 805.
    Douglas Squirrel (ill.), 157.
    Fox-squirrel (ill.), 97.
    Gray-squirrel, 38; ill., 22, 39.
    Kangaroo-rat, 434; (ill.), 432.
    Least Chipmunk (ill.), 178.
    Marsh-rabbit, 824, 834.
    Muskrat (ill.), 595.
    Opossum (ill.), 883, 886.
    Red-squirrel (ill.), 131.
    Snowshoe Rabbit, 824; (ill.), 719.
    Whitetailed Jack (ill.), 750.
    Woodchuck (ill.), 311.
Tracks in the desert, 423.
Trade-rat, *see* Packrat.
Trading instinct of Packrat, 522.
Trails, Cottontail, 804.
    Marsh-rabbit, 835.
    Mountain Beaver, 531.
transitionalis, Sylvilagus, 783.
Trapping Arctic Hare, 678.
    Beaver, 487.
    Cottontail, 788.
    Flickertail, 274.
    Mountain Beaver, 532, 543.
    Muskrat, 578.
Tree felled, Beaver (ill.), 479.
Trees cut by Beaver, 459.
    damaged by Porcupines, 627.
Tree-squirrel, Gray, *see* Gray-squirrel, California.
trepidus, Callospermophilus, 220.
tridecemlineatus, Citellus, 228, 229.
    Sciurus, 228.

tridecimlineatus, Citellus, 228.
trinitatis, Callospermophilus, 219.
Trout helped by Beaver, 497.
  as Big Flying-squirrel enemy, 390.
  breaks off Red-squirrel tail, 123.
True, Dr. Frederick William (1858–1914), zoologist U. S. Nat. Mus., obtains Roundtailed Muskrat type, 559.
Trumbull, Dr. James Hammond (1821–1897), of Yale; wrote Natick Dictionary,
  on Gray-squirrel names, 9.
Tsa, *see* Beaver.
Tsink-pay, *see* Muskrat.
Tunnels, Greenland Hare, 697.
  Gopher, 408; in snow (ill.), 411.
  Mountain Beaver, 531, 533; (ill.), 546.
  Muskrat, 587.
  Roundtailed Muskrat, 561.
  Red-squirrel in snow, 148.
Tweddell, William George (1864–), Englishman living with Cree Indians of Manitoba, acknowledgment to, vii.
  on Rabbit dead in tree, 728.
  on Snowshoe Rabbit with dermoid cysts, 728.
  on Snowshoe Rabbit year, 706.
Two-tracks, *see* Kangaroo-rat.
Type locality, Abert Squirrel, 68.
  Antelope Jack, 764.
  Apache Squirrel, 108.
  Arctic Hare, 668.
  Arizona Gray-squirrel, 112.
  Armadillo, 848.
  Beaver, 443.
  Big Flying-squirrel, 386.
  Blacktailed Jack, 736.
  Brush-rabbit, 818.
  California Gray-squirrel, 60.
  Chipmunk, 184.
  Coney, 636.
  Cottontail, 781.
  Douglas Squirrel, 152.
  Flickertail, 260.
  Franklin Ground-squirrel, 250.
  Fremont Squirrel, 162.
  Gopher, 396.
  Gray-squirrel, 9.
  Greenland Hare, 682.
  Hoary Marmot, 352.
  Kangaroo-rat, 420.
  Least Chipmunk, 170.
  Little Flying-squirrel, 368.
  Marsh-rabbit, 830.
  Mountain Beaver, 526.
  Muskrat, 569.
  Opossum, 866.
  Packrat, 504.
  Porcupine, 604.
  Prairie-dog, 276.
  Pygmy Rabbit, 840.
  Red-squirrel, 117.
  Rockchuck, 338.
  Roundtailed Muskrat, 558.
  Say's Chipmunk, 218.
  Snowshoe Rabbit, 700.
  Striped Ground-squirrel, 228.
Type locality (*Continued*)
  Swamp-rabbit, 822.
  Whitetailed Jack, 648.
  Woodchuck, 300.

UBERICOLOR, Sylvilagus, 818.
umbrinus, Thomomys, 397.
uinta, Ochotona, 637.
Ulrich, Fritz, of Georgiana, Fla., secures type of Roundtailed Muskrat, 559.
United States, Beaver numbers in, 453.
  Cottontail numbers killed in, 803.
University of California, acknowledgment to, v.
Urson, *see* Porcupine.

VALUE Market, Beaver skins, 449.
  Muskrat fur, 577.
Value to man, Abert Squirrel, 78.
  Beaver, 454, 499.
  California Gray-squirrel, 66.
  Flickertail, 270.
  Fox-squirrel, 105.
  Fremont Squirrel, 168.
  Gopher, 418.
  Gray-squirrel, 32, 56.
  Least Chipmunk, 177.
  Mountain Beaver, 543.
  Packrat, 508.
  Porcupine, 628.
  Red-squirrel, 135, 148.
  Snowshoe Rabbit, 726.
  Striped Ground-squirrel, 247.
  Whitetailed Jack, 665.
  Woodchuck, 309, 312.
vancouverensis, Marmota, 353.
  Sciurus, 119.
Vanderburgh, Mrs. Mary, on Muskrat family life, 597.
Ventilator, Gopher, 408.
ventorum, Ochotona, 637.
  Sciurus, 119.
venustus, Tamias, 185.
Vermont, Beaver numbers in, 451.
  Cottontail in, 784.
  Gray-squirrel migrate into, 16.
  Opossum in, 869.
Victorville, Calif., Kangaroo-rats near, 422.
vigilis, Marmota, 353.
Virginia, Beaver numbers in, 452.
  Cottontail numbers in, 803.
virginiana, Didelphis, 866, 867.
virginianus, Lepus, 701.
Voice, Abert Squirrel, 72.
  Armadillo, 860.
  Beaver, 478.
  Big Flying-squirrel, 389.
  Blacktailed Jack, 741, 746.
  California Gray-squirrel, 62.
  Chipmunk, 206; in song, 214.
  Coney, 640.
  Cottontail, 788.
  Douglas Squirrel, 154.
  European Hare, 654.
  Flickertail, 266.
  Fox-squirrel, 103.

- Voice (*Continued*)
  - Franklin Ground-squirrel, 253, 254.
  - Fremont Squirrel, 165.
  - Gopher, 401.
  - Gray-squirrel, 40.
  - Greenland Hare, 694.
  - Hoary Marmot, 357.
  - Kangaroo-rat, 431.
  - Least Chipmunk, 181.
  - Little Flying-squirrel, 373.
  - Mallard, 40.
  - Mountain Beaver, 551.
  - Muskrat, 586.
  - Opossum, 881.
  - Porcupine, 611.
  - Prairie-dog, 291.
  - Red-squirrel, 143.
  - Rockchuck, 342.
  - Say's Chipmunk, 223.
  - Snowshoe Rabbit, 732.
  - Striped Ground-squirrel, 234.
  - Whitetailed Jack, 654.
  - Woodchuck, 313.
- Vogt, W. C., on Beaver and trout, 497.
- volans, Glaucomys, 368, 369.
  - Mus, 368.
- Von Schriltz, Guy W., of Cold Water, Kansas, takes horned Cottontail, 787.
- Vorhies, Prof. Charles Taylor (1879–), entomologist, Univ. Ariz., acknowledgment to, vi.
  - on Antelope Jack salt-lick, 773.
  - on Antelope Jack young, 770.
  - trip to see Antelope Jack, 776.
- vulture and Armadillo myth, 862.

- WABASSO, *see* Snowshoe Rabbit.
- Wabbles, *see* Warbles.
- Wadsworth, Hon. Daniel, of Hartford, Conn.,
  - on Woodchuck hibernation, 320.
  - on Woodchuck tamability, 327.
- wah-boos, *see* Snowshoe Rabbit.
- Wah-chusk, *see* Muskrat.
- wah-hin-hay-yah, *see* Gopher.
- Wah-jusk, *see* Muskrat.
- Wah-poos, *see* Snowshoe Rabbit.
- Wah-sesk, *see* Muskrat.
- Walker, Ernest P., zoologist, U. S. Biol. Surv., on Red-squirrel range, 121.
- Walker, Dr. James R., physician to Sioux, Pine Ridge, So. Dak., acknowledgment to, vii.
- Walker, Dr. Hy. F., of N. Y. C., on earthworms, 413.
- wallawalla, Lepus, 737.
- Walton, Mason A. ("Hermit"), naturalist, Gloucester, Mass., on Red-squirrel and mushrooms, 132.
- Warbles, Bot fly, enemy to Cottontail, 800.
  - enemy to Packrat, 511.
  - *see also* Cuterebra and Parasites.
- Warren, Edward Royal, zoologist, Colo. Sprgs. (1860–), acknowledgment to, v, vi.
  - on Abert Squirrel numbers, 70.
  - on Flickertail *vs.* Weasel, 272.
  - on Fremont Squirrel cache, 166.
  - on Fremont Squirrel nests, 165.
- Warren, Edward Royal (*Continued*)
  - on Fremont Squirrel storage, 166.
  - on tame Fremont Squirrel, 165.
  - on Fremont Squirrel young, 165.
  - on Least Chipmunk tamability, 179.
  - on Least Chipmunk young, 175.
  - on Muskrat catching lizard, 583.
  - on Muskrat mother devotion, 600.
  - on Rockchuck breeding, 343.
  - on Rockchuck hibernation, 348.
  - on Say's Chipmunk food, 221.
  - on Say's Chipmunk range, 220.
  - on tame Say's Chipmunk at Long's Peak Inn, 223.
- Warren, Sam, hunter, Blythesville, Ark., on Gray-squirrel numbers in Missouri and Arkansas, 27.
  - on Gray-squirrel nocturnalism, 49.
- warreni, Marmota, 339.
- "Wash," Beaver, 469.
- Washington, Beaver in, 452.
- Washington, D. C., Gray-squirrel hibernate in, 35.
  - Gray-squirrel numbers in, 26.
- washingtonii, Lepus, 702.
- Wasp combs eaten by Red-squirrel, 133.
- Was-usk, *see* Muskrat.
- Water control, by Mountain Beaver, 535.
  - by Beaver, 460.
  - *see also* Dams.
- Water-rat, *see* Muskrat, Roundtailed.
- Waterhouse, George Robert (1810–1888), famous British mammalogist.
  - names Brush-rabbit, 819.
- Watkins, George, of Nevada, on Rabbit disease, 752.
- Watson, Winslow Cossoul (1803–1884), historian Essex Co., N. Y., on Red-squirrel swimming, 120.
- Wat-susk, *see* Muskrat.
- Waugh, Dr. Reuben James, of Carberry, Man.,
  - on Red-squirrel as birdicide, 135.
  - on Red-squirrel numbers, 119.
  - on Red-squirrel storage, 134.
- Way of life, Abert Squirrel, 75.
  - Antelope Jack, 773.
  - Arctic Hare, 678.
  - Arizona Gray-squirrel, 113.
  - Armadillo, 861.
  - Big Flying-squirrel, 393.
  - Blacktailed Jack, 753.
  - California Gray-squirrel, 63.
  - Chipmunk, 211.
  - Coney, 640.
  - Douglas Squirrel, 156.
  - Fox-squirrel, 101.
  - Fremont Squirrel, 167.
  - Gopher, 402.
  - Gray-squirrel, 47.
  - Hoary Marmot, 359.
  - Kangaroo-rat, 429, 436.
  - Least Chipmunk, 177.
  - Mountain Beaver, 548.
  - Opossum, 895.
  - Porcupine, 629.
  - Prairie-dog, 291.

Way of life (*Continued*)
  Red-squirrel, 147.
  Rockchuck, 345.
  Roundtailed Muskrat, 564.
  Snowshoe Rabbit, 729.
  Striped Ground-squirrel, 235.
  Swamp-rabbit, 825.
  Whitetailed Jack, 664.
  Woodchuck, 331.
Weasel, enemy to Arctic Hare, 673.
  enemy to Big Flying-squirrel, 390.
  enemy to Blacktailed Jack, 751.
  enemy to Chipmunk, 196; (ill.), 206.
  enemy to Coney, 644.
  enemy to Cottontail, 798.
  enemy to Flickertail, 271.
  enemy to Franklin Ground-squirrel, 257.
  enemy to Gopher, 405.
  enemy to Gray-squirrel, 52.
  enemy to Kangaroo-rat, 434.
  enemy to Mountain Beaver, 542.
  enemy to Muskrat, 592.
  enemy to Prairie-dog, 296.
  enemy to Red-squirrel, 124.
  enemy to Say's Chipmunk, 224.
  enemy to Snowshoe Rabbit, 723.
Wee-nee Suk-ah-tip, *see* Woodchuck.
Weenusk, *see* Woodchuck.
Weight, Antelope Jack, 764.
  Arctic Hare, 668.
  Armadillo, 848.
  Beaver, 444.
  Blacktailed Jack, 736.
  California Gray-squirrel, 60.
  Cottontail, 782.
  European Hare, 666.
  Flickertail, 260.
  Fox-squirrel, 82.
  Gray-squirrel, 10.
  Greenland Hare, 682.
  Hoary Marmot, 352.
  Marsh-rabbit, 830.
  Mountain Beaver, 527.
  Muskrat, 569.
  Opossum, 866.
  Packrat, 505.
  Porcupine, 604.
  Prairie-dog, 276.
  Red-squirrel, 117.
  Rockchuck, 338.
  Roundtailed Muskrat, 558.
  Say's Chipmunk, 219.
  Snowshoe Rabbit, 700.
  Swamp-rabbit, 822.
  Whitetailed Jack, 649.
  Woodchuck, 301.
Wejack, name for Fisher, 300.
Welch, Major William A., Supt. of Interstate Park, N. Y., on Beaver use of tail, 458.
West Virginia, Beaver numbers in, 452.
Wheat as Kangaroo-rat food, 425.
Wheel, Gray-squirrel on revolving, 51.
  a delight to Little Flying-squirrel, 382.
Wheeler, Arthur Oliver, Alpine Club, Canada, on Hoary Marmot numbers, 355.
Wheeler, Dunham, sportsman, N. Y., on Deer and Snowshoe Rabbit coloration, 703.
Whiskers, Mountain Beaver, 527; (ill.), 542.
Whistle-pig, *see* Woodchuck.
Whistler, *see* Woodchuck.
  Golden-mantled, *see* Rockchuck.
  Gray, *see* Marmot, Hoary.
  Mountain, *see* Marmot, Hoary.
  White, *see* Marmot, Hoary.
  Yellow, *see* Rockchuck.
  of the Peaks, *see* Marmot, Hoary.
  of the Rocks, *see* Marmot, Hoary.
Whistling Sneak, *see* Ground-squirrel, Striped.
White, Reginald, of Antler, Sask., gets Opossum in Saskatchewan, 870.
White, William H., J. P., Carberry, Man., on Whitetailed Jack home range, 652.
White Sand Lake, Wis., Red-squirrel swims, 120.
Wilbar, Lincoln, hunter on Gray-squirrel freezing, 50.
Wilcox, Timothy Erastus of Vancouver Barracks, Wash. Terr., on earthworms, 413.
Wild fire and Packrat, 515.
Wilding, Charles A., banker, Fort Wayne, Ind., on snapper full of Porcupine quills, 623.
Williams, Miss Essie W., of Hudson, Wis., on Gray-squirrel moving young, 46.
Williams, Milton, of Laingsburg, Mich., on eagle *vs.* Porcupine, 623.
Williamson, Rev. John Poage (1835–1917), missionary to Sioux, pub. Sioux Dictionary, on Opossum names, 866.
Wilson, Alexander, "father of American ornithology" (1766–1813), on Chipmunk as birdicide, 200.
  on voice of hermit thrush, 551.
Winstanley, J. H., of Kempton, Ind., on Cottontail swimming, 795.
Winter, enemy to Muskrat, 593.
  enemy to Say's Chipmunk, 224.
Winter life, Coney, 644.
  Red-squirrel, 148.
Wisconsin, Gray-squirrel migration from, 17.
  Gray-squirrel migration in, 18.
  Opossum in, 870.
  Whitetailed Jack in, 652.
Wistonwish, *see* Prairie-dog,
Wittfeld, Dr. William, of Georgiana, Fla., sends type Roundtailed Muskrat to Dr. True, 559.
Wolf, enemy to Arctic Hare, 673.
  enemy to Beaver, 491.
  enemy to Blacktailed Jack, 751.
  enemy to Gray-squirrel, 52.
  enemy to Greenland Hare, 695.
  enemy to Muskrat, 593.
  enemy to Opossum, 893.
  enemy to Packrat, 510.
  enemy to Prairie-dog, 296.
  enemy to Rockchuck, 344.
  killed by Porcupine quills, 622.
Wolverine, enemy to Arctic Hare, 673.
  enemy to Beaver, 491.
Wood, A. A., ornithologist of Cold Stream, Ont., on Chipmunk as birdicide, 200.
Wood, Jessup S., takes Opossum in Michigan, 870.

Wood, Norman Asa (1857–), son of above, naturalist, Univ. Mich., on Cottontail swimming, 795.
on Fox-squirrel in Michigan, 84.
on Opossum in Michigan, 869.
on Opossum abroad in winter, 894.
Woodchuck, contents, 299; life, 300; (ill.), 302; burrow (ill.), 329; feet (ill.), 311, 317; head (ill.), 317, 322; map, 341; mastology (ill.), 311, 322; teeth, 301; teeth (ill.), 322; track (ill.), 311.
Western, *see* Rockchuck.
Woodcraft Expedition, N. M. and Ariz., 1927, on Abert Squirrel freezing, 76.
Woodcraft League (founded 1902), Executive Secretary of, 199.
Wood-rat, *see* Packrat.
Woodruffe-Peacock, Rev. E. Adrian, on European Hare voice, 745.
on European Hare young, 741.
Woods, Avon, on Muskrat enticed by duck call, 584.
Woodshock, *see* Woodchuck.
Woodstock, N. Y., Red-squirrel at, 122.
Workshop, Fox-squirrel, 102.
Red-squirrel, 128.
wortmani, Callospermophilus, 220.
Wright, Dr. John, on Chipmunk storage, 225.
Wright, William Henry (1856–), hunter-naturalist, Spokane, Wash.
on Grizzly *vs.* Hoary Marmot, 360.
on Hoary Marmot den, 356.
on Hoary Marmot weight, 352.
Wright, Prof. William Harmon (1885–), bacteriologist, Madison, Wis., on pickerel eating Red-squirrel, 125.
Wyoming, Beaver in, 452.
Rockchuck numbers in, 342.

XANTI, Lepus, 738.
Xenarthra Order, characteristics of, 5.

YANCEY Beaver ponds (ill.), 464.
Yapper, Mound, *see* Prairie-dog.
Yap-rat, *see* Prairie-dog.
Yek-Yek, *see* Prairie-dog.
Yellow-belly, *see* Rockchuck.
see also Squirrel, Douglas.
Yellowfoot, *see* Rockchuck.
Yellow-jacket kills Prairie-dog, 295.
Yellow-robe, *see* Rockchuck.
Yellowstone Park, Flickertail in, 263.
Least Chipmunk in, 175.
Rockchuck numbers in, 340.
Rockchuck young in, 343.
York Factory, Red-squirrel at, 117.
Young, Abert Squirrel, 74.
Antelope Jack, 77.
Apache Squirrel, 108.
Arctic Hare, 675.
Armadillo, 854.
Beaver, 474.
Big Flying-squirrel, 392.
Blacktailed Jack, 741.
California Gray-squirrel, 63.
Young (*Continued*)
Chipmunk, 193, 194.
Coney, 644.
Cottontail, 808; (ill.), 805.
Douglas Squirrel, 154.
Flickertail, 268.
Fox-squirrel, 95.
Franklin Ground-squirrel, 254.
Fremont Squirrel, 165.
Gopher, 401.
Gray-squirrel, 44.
Greenland Hare, 691.
Kangaroo-rat, 436.
Least Chipmunk, 175.
Little Flying-squirrel, 378.
Marsh-rabbit, 834.
Mountain Beaver, 542.
Muskrat, 598, 599.
Opossum, 876.
Packrat, 517.
Porcupine, 614, 615.
Prairie-dog, 289.
Pygmy Rabbit, 844.
Red-squirrel, 139.
Roundtailed Muskrat, 563.
Say's Chipmunk, 224.
Snowshoe Rabbit, 720; (ill.), 726.
Striped Ground-squirrel, 233.
Swamp-rabbit, 825.
Whitetailed Jack, 656.
Woodchuck, 316.
Young, Senator Lafayette (1848–), editor, Des Moines, Ia., on Opossum in Iowa, 870.
Young, Lieut. Gen. Samuel Baldwin Marks, U. S. A. (1840–1924), Supt. Yellowstone Park,
on size of Beaver dam, 465.
yucatanicus, Sylvilagus, 783.
yukonensis, Glaucomys, 387.

ZA-LAK, *see* Brush Rabbit.
zalopha, Ondatra, 570.
zaphæus, Glaucomys, 387.
Zee-cha, *see* Red-squirrel.
zibethica, Ondatra, 569, 570.
zibethicus, Castor, 569.
Ondatra, 569.
Zon, Raphael (1874–), director Lake States Forest Exper. Sta., St. Paul. Minn., on Snowshoe Rabbit damage, 726.
Zoo, National, Washington, D. C., outcast Beaver in, 477.
Gray-squirrel buries nut in winter at, 34.
Gray-squirrels hibernate in, 36.
Prairie-dogs at, 280, 291; (ill.), 278.
Zoo, New York, i. e., New York Zoological Park, N. Y. C., Franklin Ground-squirrel at, 254.
albino Woodchuck in, 302.
Zoo, Washington, *see* Zoo, National.
Zoo, Winnipeg, Beaver in (ill.), 470.
Zoological Society, New York, acknowledgment to, v.
zuniensis, Cynomys gunnisoni, 278.

(The author will be grateful for corrections or for details needed to complete this index.)